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MINERALS OF CALIFORNIA

BULLETIN No. 87

ISSUED BY THE

CALIFORNIA STATE MINING BUREAU

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BULLETIN No. 67

Minerals of California

COMPLIMENTS OF
F. McN. HAMILTON
STATE MINERALOGIST

By ARTHUR S. EAKLE, Ph.D.

MARCH, 1914

Issued by California State Mining Bureau
F. McN. HAMILTON
STATE MINERALOGIST

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LETTER OF TRANSMITTAL.

To his Excellency, the HON HIRAM W. JOHNSON,
Governor of the State of California.

SIR:

I have the honor to transmit herewith Bulletin 67 of the State Mining Bureau upon the Minerals of California.

This work was made possible at this date through the co-operation of Prof. Arthur S. Eakle, Ph.D., of the Department of Geology and Mineralogy of the University of California, with this Bureau. Dr. Eakle has given freely of his time and effort and has closely checked his own records with those of this Department in order that the most complete list of minerals possible be published.

It is hoped that this bulletin will be of service to the mineral industry.

Respectfully submitted.

FLETCHER MCN. HAMILTON,
State Mineralogist.

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INTRODUCTION

The first list of California minerals was published by W. P. Blake in 1866, and it comprised about seventy-five mineral species. At that early time California was a new and largely unexplored field, and only a few scattered localities were known for mineral specimens; consequently the list was short and not at all representative.

The second list appeared in 1884 as a part of the Fourth Annual Report of the State Mining Bureau, by Henry G. Hanks, who was then State Mineralogist. This list included double the number of previously known minerals, and gave detailed descriptions of some of the localities, and much instructive matter relating to minerals of economic value.

Since the appearance of the second list, our knowledge of the geology and mineralogy of the State has vastly increased. The ore deposits of many of the counties, the gem and borate deposits of the southern counties, and the petrography of many districts, have been investigated and described, so that our present knowledge of the mineralogy of the State is much more general.

The present list contains more than double the number of definite mineral species given by Hanks, besides many sub-species and varieties. The desire has been to make the list as complete as possible of the known minerals, and where they occur, but the list of localities where the same mineral might be found is necessarily incomplete. Many minerals are so commonly distributed throughout the State, such as small bodies or pockets of metallic minerals and the rock-forming minerals, that it would be useless and impossible to cite all of their occurrences. In such a vast area as California, localities may be known to local collectors where excellent specimens may occur, unknown to the author. Some minerals may be known to occur in the State which have not been mentioned in this work, but it is believed that they will be very few in number.

So many minerals and localities are included in the list, that geological and petrographical descriptions in detail, have had to be omitted, and reference must be made to the bibliography at the end of the work

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under the author's name and number. This bibliography includes with few exceptions, only those articles which bear directly on the minerals of the State, omitting the great amount of literature of a general nature on the geology and mining industry of the State. The excellent bibliography of A. W. Vodges, Bulletin 30 of the State Mining Bureau, may be referred to for such literature.

The various kinds of minerals have been grouped under a chemical classification in order to be more instructive and show better the relations of the various species and varieties. The crystal forms have been cited and the chemical analysis given, to show what has been done in these two lines of work on California minerals.

New minerals and important localities for known minerals are constantly being discovered as California becomes more settled and prospected, and this list must be considered more as a check-list to form a basis for continual additions.

March, 1914.

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CHAPTER I.

NATIVE ELEMENTS.

Non-metals.	*Metals.*	*Metals.*
Diamond.	Gold.	Platinum.
Graphite.	Gold amalgam.	Iridium.
Sulphur.	Bismuth gold.	Platiniridium.
	Electrum.	Palladium.
	Silver.	Iridosmine.
Semi-metals.	Copper.	Osmium.
Antimony.	Mercury.	Rhodium.
Arsenic.	Lead.	Ruthenium.
Bismuth.	Tin.	Iron.
Tellurium.	Zinc.	Awaruite.

1. DIAMOND.

Native carbon, C.

Isometric. Octahedrons and hexoctahedrons common. Crystal faces often curved. Perfect octahedral cleavage. Brittle. Yellow and colorless crystals common. Red, orange, green, blue, brown and black are rarer shades. H = 10; G = 3.5.

Bort is a hard rounded form without distinct cleavage, unsuitable for gems.

Carbonado is a hard black variety without cleavage.

Diamonds were found in California soon after placer mining began. As early as 1849, Lyman[3] reported seeing a pale yellow crystal about the size of a small pea, which came from one of the placers. A few years later they were observed in the gold gravels at Cherokee, Butte County, and this locality became the most noted one in the State for the number found.

Placer deposits elsewhere have also yielded them from time to time, so their occurrence has not been limited to any one field. No record has been kept of the total number found but it is probably between four and five hundred. Since all of them have been chance finds, there can be no doubt that many more have been overlooked or destroyed. A few of the stones found are over two carats in weight and of good quality, but the majority are small and mostly "off color," usually with a pale yellow tinge. Most of these diamonds now in the possession of different individuals were found during the days when placer mining and hydraulicking were at their height, and since that time diamond finds have been rare.

The mode of origin and sources of the diamond are as yet unknown. They have only been found in placer gravels and in "black sands" and concentrates of placer mines. Presumably their origin has been in the basic igneous rocks from which the serpentines of the gold regions

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have been derived, and continued search may yet reveal them *in situ*. The discovery near Oroville of an apparent pipe of serpentinized rock bearing a resemblance to the diamond pipes of South Africa has led to some active operations on the part of the United States Diamond Mining Company, and a shaft has been sunk, which has not proved successful. The rock is a hard eclogite differing in its character from the kimberlite of South Africa. Hanks[6] gives an interesting account of the diamonds found during the early days of gold mining, and Turner[6] contributes a short article on California diamonds.

Amador County: A few small stones have been picked up near the towns of Volcano, Oleta and Fiddletown.

Butte County: In 1853 it was observed that diamonds occurred in the gravels at Cherokee Flat, about nine miles north of Oroville. More than three hundred good diamonds have been obtained from the placers in this district and it leads all other districts in the State. It seems quite probable that the source of these diamonds is not far from this vicinity. Silliman[7][8] gave the contents of the black sands at Cherokee as platinum, iridium, iridosmine, gold, pyrite, chromite, magnetite, limonite, diamonds, quartz, rutile, almandite garnet, topaz, zircon and epidote.

El Dorado County: A diamond weighing 1¼ carats was found at Forest Hill. About sixty have been found near Placerville, namely, on Webber Creek, in White Rock canyon and at Smith's Flat.

Fresno County: Small diamonds are reported to have been found a few miles north of Coalinga.

Nevada County: A 1½ carat stone was found at French Corral.

Siskiyou County: Diamonds occur in the placer gravels at Hamburg Bar.

Trinity County: Microscopic examinations of the black sands of Trinity River and some of its tributaries have shown the presence of small diamonds as a constituent of these sands.

2. GRAPHITE—Plumbago—Black Lead.

Native carbon, C.

Hexagonal, rhombohedral. Commonly in scaly or foliated masses. Color dark steel-gray to dull black. Perfect basal cleavage. Soft with greasy feel. H=1—2; G=2.2.

Graphite is a common constituent of crystalline limestones and is often disseminated through the limestone in minute flakes and in larger foliated masses. It is also prominent as layers in some schists and gneisses and when present in considerable amount the graphitic gneiss or schist is sometimes mined for the graphite. In mining districts it is often seen coating the walls of veins and mixed with the talcose gouge.

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No extensive deposits of good quality graphite are known to occur in the State, but a few small deposits have been worked for the manufacture of paints and lubricants. Much of the graphite of California is so intimately mixed with silica that its separation as pure material is too expensive an operation. It is typically a constituent of metamorphic rocks and as such may be found in every county. Aubury[3] describes some of the deposits of the State.

Calaveras County: It occurs in the copper-bearing schists, and specimens have come from Copperopolis and Campo Seco.

Del Norte County: The limestone near Gasquet contains foliated plates of the mineral.

Fresno County: Prominent mineral in the rocks near Dunlap and at Borer Hill.

Humboldt County: Occurs near Eureka.

Los Angeles County: Found in the schists at West Carbondale and in the limestone near Elizabeth Lake. A deposit of graphite gneiss is said to occur in the Verdugo Canyon, ten miles northeast of Los Angeles.

Mendocino County: A deposit occurs about fifteen miles east of Point Arena which has been worked for paint and lubricant.

Monterey County: Graphite is disseminated in the limestones and metamorphics of the Santa Lucia range, south of Monterey.

San Bernardino County: Large deposits are said to exist in San Bernardino mountains, fifteen miles from East Highlands, Aubury[3]. It is also found as a constituent of the limestone near Colton and near Oro Grande.

Santa Cruz County: Occurs in flakes and foliated masses at the limestone quarries near Santa Cruz.

Sonoma County: A deposit near Guerneville, one a few miles south of Healdsburg and one four miles south of Petaluma, are known in this county. Specimens have come from Cazadero, Pine Flat and Santa Rosa.

Tulare County: Graphite occurs in metamorphic rock in Drum Valley, north of Auckland, and on quartz at Three Rivers.

Tuolumne County: Large foliated masses and dull earthy masses of the mineral occur in the limestones north of Sonora, near Columbia. The mineral was formerly mined here, but none is now produced.

3. SULPHUR.

Native sulphur, S.

Orthorhombic. Common in small crystal coatings and incrustations. Sulphur—yellow color. Resinous luster. H = 1.5—2.5; G = 2.

Yellow sulphur is common in the vicinity of geysers, hot springs and volcanoes as sublimations from the emitted hydrogen sulphide gas in

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contact with the air, and as precipitations from solfataric waters. It is commonly found in gypsum beds as a reduced product, and in association with borax. No workable deposits are known in the State. For the manufacture of sulphuric acid, pyrite deposits and pyrite concentrates from the gold and copper mines are utilized.

Colusa County: On the banks of Sulphur Creek solfataric action has produced fine crystallized masses and granular coatings of the mineral, sometimes in association with cinnabar and good specimens have come from the Manzanita mine.

Imperial County: The mud volcanoes near Volcano have rims of sulphur crystals associated with gypsum and salt. These volcanoes have been described by Hanks[4].

Inyo County: Sulphur Bank on Owens Lake, near Olancha contains a deposit of the mineral. Specimens of sulphur with fluorite and gypsum have been found in the Defiance mine.

Kern County: On both sides of the San Joaquin Valley impure beds of gypsum and limestone occur, having considerable sulphur intermixed. It is mixed with alum in the Sunset district.

Lake County: At the Sulphur Bank quicksilver mine, situated on Clear Lake, a very interesting deposit of sulphur occurs which was described by Le Conte and Rising[1] and by Becker[1]. The black basaltic rock which outcrops on the lake has been bleached white and altered to a porus mass of silica by the action of the sulphuric acid fumes coming from several hydrogen sulphide vents. The pores and cavities of this altered mass of rock have had deposited in them brilliant crystals of sulphur and acicular crystals of cinnabar. The forms of the sulphur crystals are: (111), (113), (011), (101), and (001). Sulphur was obtained in considerable quantity from this deposit before it was discovered to overlie the much richer deposit of cinnabar. Sulphur also occurred associated with borax at Little Borax Lake, just south of Clear Lake.

Mariposa County: Crystals of sulphur have been found with cinnabar on Horseshoe Bend Mountain, near Coulterville.

San Bernardino County: Occurs at Searles Borax Lake as one of the many associated minerals of borax.

Sonoma County: Native sulphur is found at the Geysers.

Tehama County: A large crystalline deposit is said to exist on the south slope of Lassen Butte in the northeastern part of the county.

Ventura County: Deposits occur in Sulphur Mountain, three miles east of Fillmore, and at the borate deposit of the Frazier Mountains.

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4. ANTIMONY.

Native antimony. Sb.

Hexagonal-rhombohedral. Generally massive. Perfect basal cleavage. Very brittle. Color and streak tin-white. H=3—3.5. G=6.65—6.72. Metallic luster.

Masses of metallic antimony are sometimes found associated with the sulphide of antimony, stibnite, but the mineral is comparatively rare.

Kern County: Large nodules of metallic antimony, coated with white oxide of antimony have been found on Erskine Creek, east of Vaughn. It has also been found in the Buffalo mine and in the antimony mines of the San Emidio Mountains, in the southwestern part of the county.

5. ARSENIC.

Native arsenic, As.

Hexagonal-rhombohedral. Generally granular massive in reniform shapes. Perfect basal cleavage. Brittle. Color and streak tin-white but surface usually tarnishes dark gray or black. Luster metallic. H=3.5; G=5.63—5.73.

Metallic arsenic is a rare mineral and its existence in the State is doubtful. Arsenic is common in the concentrates of many of the gold mines, but it comes from such minerals as arsenopyrite or arsenical tetrahedrite.

Monterey County: The native metal was said to have been found in the old Alisal mine on El Rancho Alisal, about eight miles southeast of Salinas, in the foothills of the Gabilan range, W. P. Blake[9]. This mine contained a small body of argentiferous galena and sphalerite.

6. BISMUTH.

Native bismuth, Bi.

Hexagonal-rhombohedral. Usually in arborescent-reticulated shapes. Color silver-white with reddish tinge, tarnishing dark brown. Luster metallic. H=2—2.5; G=9.70—9.83.

Crystals and veinlets of metallic bismuth sometimes accompany ores of bismuth, cobalt, silver and gold. It is also occasionally found in pegmatitic veins. When bismuth occurs in the concentrates of gold and copper ores it probably is present as a sulphide.

Inyo County: Found with bismuthinite at Big Pine Creek and at Antelope Springs, Deep Spring Valley.

Mono County: Specimens have occurred at Oasis.

Nevada County: The concentrates of the Providence mine, Nevada City, contained the element, according to Lindgren[6].

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San Diego County: Upwards of a hundred pounds of metallic bismuth have been obtained from the pegmatitic vein of quartz, lepidolite, feldspar, tourmaline and amblygonite at the Stewart mine of the American Lithia company, at Pala. The mineral occurred in platy and long prismatic crystals, one of which was a pseudomorph after feldspar. The occurrence was described by Kunz[5]. The native bismuth is also found in small metallic cleavages in lepidolite at the Victor mine Rincon. Rogers[3].

Tuolumne County: Minute crystals of bismuth have been observed in the gold ore at the Soulsby mine.

7. TELLURIUM.

Native tellurium, Te.

Hexagonal-rhombohedral. Generally massive. Perfect prismatic cleavage. Brittle, and sectile. Color and streak tin-white. Luster metallic. H=2. — 2.5; G=6.1 — 6.3.

Metallic tellurium is sometimes found in association with the tellurides of gold, silver, lead and bismuth, but it is of rare occurrence. It is occasionally found in the gold concentrates when not visible in the ore, and has been reported from some of the mining districts of the State.

Calaveras County: Carson Hill, a low hill on the north bank of the Stanislaus River, a few miles south of Angels, was one of the most noted places along the Mother Lode for telluride minerals, and it was here that the two new tellurides, calaverite and melonite were found. The old Stanislaus mine and the Melones mine contained foliated masses of native tellurium with the gold tellurides.

Shasta County: Native tellurium was found in the Eureka mine, near Churntown.

Tuolumne County: Some metallic tellurium has been found associated with tellurides of gold and silver in the mines near Tuttletown and Jamestown.

8. GOLD.

Native gold, Au.

Isometric. Good crystals are rare. Common in grains, scales, plates and arborescent forms. No cleavage. Highly malleable and ductile. Color gold-yellow. H=2.5 — 3.0; G=15.6 — 19.3.

Gold has a very wide distribution in California and it has always been the chief mineral product of the State. It has been found in every county and is now produced in two thirds of them. Practically all of the gold exists as the native metal, either as free gold in the

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quartz or else mechanically mixed with the sulphides of iron, copper, lead or zinc. Tellurides of gold occur, but they are quite subordinate in quantity.

Crystals, arborescent groups, spongiform masses, wires, plates, scales, grains, nuggets and every shape known for gold, have been found. Cubes, rhombic-dodecahedrons and octahedrons are the prevailing forms of the crystals. The forms given by E. S. Dana [1] and Alger[1] for some placer gold crystals were: (111), (311), (18.10.1) and (421), with twinning on the octahedral plane. Crystalline masses and nuggets of large size have occurred in the placer gravels and in the pockets of quartz veins. One found in 1854 at Carson Hill, Calaveras County, weighed 2,340 troy ounces, and another found in 1860 at the Monumental mine, Sierra Buttes, weighed 1,596 ounces. Many valuable nuggets and masses have been found and Hanks[4] gives a descriptive list of some of them.

Gold in quartz is the usual association and the mineral is often in the quartz in such a finely divided state as to be invisible, even in high grade rock. Flaky gold has been found implanted on clear quartz crystals at Placerville and elsewhere.

Gold in pyrite, or "auriferous pyrite," is abundant and this gold-bearing pyrite is the source of much of the gold produced in the State.

Gold in arsenopyrite is also common in the Mother Lode region and in the Alleghany district, Sierra County.

Gold with calcite as a gangue mineral is not uncommon, and in some mines considerable calcite is found with wires and scales of included gold. Lenticular masses of calcite with much gold are found in Minersville, Trinity County. Diller[1]. It has been found with calcite at the Palma mine, Inyo County, at the Yellowstone mine, Mariposa County, in the Soulsby mine, Tuolumne County, and in the Calico district, San Bernardino County.

Gold in barite is uncommon, yet barite is found to be a gangue mineral in the copper-gold districts as well as in the silver-lead districts. It occurs in barite at Pine Grove, Nevada County, in the Morning Star mine, Big Bend, Butte County, at the Malakoff mine, North Bloomfield, Nevada County, and in the barite of some of the Shasta County copper mines.

Gold in cinnabar is an exceptional occurrence, yet the association has been noted in a few localities. At the old Manzanita mine in the Sulphur Creek district, Colusa County, minute specks of gold occurred in the cinnabar and implanted on cinnabar crystals; also in the old Redington or Boston mine, Knoxville, Napa County, some gold has been found with the cinnabar, and likewise near Coulterville, in the Horseshoe Bend mountain, Mariposa County.

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In addition to the above, gold has been observed with graphite, galena, altaite, petzite, hessite, tetradymite, calaverite, native tellurium, chalcopyrite, chalcocite, native bismuth, stibnite, sphalerite, tetrahedrite, fluorite, chalcedony, jasper, cuprite, magnetite, hematite, limonite, pyrolusite, dolomite, ankerite, rhodochrosite, siderite, albite, rhodonite, mariposite, chlorite, roscoelite, talc, serpentine, asbestos, chrysocolla, and asphaltum. Gold is not confined to one class of rocks, although the gold-bearing quartz veins are principally in metamorphic schists and slates. The original source of the gold has been the igneous rocks and it has been found in granites, syenites, monzonites, granodiorites, diorites, rhyolites, quartz-porphyries, andesites, porphyrites and diabases. It has been deposited, with quartz or as impregnations, in such metamorphic rocks as gneisses, amphibolites, chlorite-schists, talc-schists, mica-schists, slates and quartzites, and in sedimentary conglomerates, sandstones and shales.

The great supply of gold was brought into California with the intrusion through the Mesozoic sediments of the mass of igneous granitic rock which forms the core of the lofty Sierras. The intrusion of the great plutonic mass lifted on high the overlying sediments, tilted, folded, faulted, and metamorphosed the Cretaceous sediments on the flanks of the uplift into slates, schists, quartzites and crystalline limestones, and in the joints and fissures of the granitic and metamorphic rocks, gold-bearing quartz was deposited, forming veins and seams of the precious metal.

Then followed a long period of erosion in the Cretaceous and Tertiary time in which the high mountain masses were planed down nearer to their present levels, and the gold became concentrated and deposited with the gravels along the stream beds, and in the valleys and canyons, forming the numerous placer deposits.

Volcanic eruptions took place in the late Tertiary and much of the surface in the northern counties became covered with thick layers of rhyolitic and andesitic lavas and tuffs. The old placers became buried under this mass of volcanic rock and mud, and new river channels, valleys and canyons, and new placer deposits were formed by the extensive erosion during the late Pliocene and early Quarternary time.

Some gold is found in the Coast Range and some is mined in the southern counties, but the great bulk of the precious metal comes from the northern half of the State and from those counties bordering on, and intersected by, the Sierra Mountains.

Gold occurs in so many localities in the State that it would be useless to try to enumerate them. The literature on the gold deposits is also extensive.

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GOLD AMALGAM.—A native alloy of gold and mercury very rarely found.

Mariposa County: It occurred in some of the mines near Mariposa and was analysed by Sonnenschein[1].

Analyses:	Au	Hg
	39.02	60.98 per cent
	41.63	58.37

Nevada County: It was reported from the Odin shaft, Grass Valley, by Lindgren [6].

ELECTRUM.—A pale yellow alloy of gold and silver of rather frequent occurrence where considerable silver is found with gold.

Imperial County: Considerable quantity of electrum is said to have been found in the Oro Plata mine, in the extreme eastern part of the county.

Madera County: Wire electrum occurred with gold in Fine Gold Gulch.

Placer County: It occurred with the gold in the Ophir District, according to Lindgren[4], and was analysed by Hillebrand.

Analysis:	Ag	Au
	27.91	72.09 per cent

BISMUTH GOLD.—An alloy containing about 60 per cent gold and 40 per cent bismuth.

El Dorado County: Observed in the Coon Hollow mine near Placerville.

9. SILVER.

Native silver, Ag.

Isometric. Crystals rare. Generally in wires, arborescent shapes and massive. Color silver-white but soon tarnishes to dark brown. Malleable and ductile. Metallic luster. H=2.5—3; G=10.5.

Native silver has not been found in any large masses in the State, yet the element is quite universally present in the gold and copper districts, and occasionally arborescent crystallizations, wires and thin sheets are found in the mines of these metals. It is more common, however, in the silver-lead districts, where it occurs often near the walls of veins or in the vicinity of intrusive dikes, as a reduction product.

Alpine County: The Silver Mountain district has yielded good specimens of native silver.

Calaveras County: Occurred in arborescent forms with the copper ore at Quail Hill.

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Inyo County: This is one of the silver counties of the State and has several deposits of argentiferous galena, tetrahedrite and silver-antimony minerals, formed along the contact between limestone and the granitic rock of the Inyo, Coso and Argus ranges. Fine specimens have come from the old Cerro Gordo district and also from the Kearsarge district near Independence.

Kern County: In the Amalic district and near Garlock it occurs with the silver minerals.

Los Angeles County: Native silver was associated with argentite, and with cobalt and nickel minerals, at the Kelsey mine in San Gabriel Canyon.

Mono County: In the silver district at Blind Spring Hill, near Benton, the native metal was frequent, associated with tetrahedrite and partzite. The Diana mine and the Comache mine of this district have produced good specimens. At Bodie it has been found with the copper-gold ores. In the Sweetwater range, north of Bridgeport, native silver occurs associated with gold, cerargyrite, argentite, etc.

Placer County: Occurs as one of the associated minerals with gold at the Ophir mine, Lindgren[4].

Plumas County: Some native silver has been found in the old Pocahontas mine associated with native copper and cuprite.

San Bernardino County: This county has long been known for its deposits of silver haloids. The Calico district, described by Lingren[1] and Storms[1], the Grapevine district, the Silver Reef district and the Silver Mountain district have all produced some native silver with the cerargyrite and embolite of the mines. Native silver with gold occurs in the Avawatz Mountains.

Shasta County: Native silver is rare in the copper deposits of this county, but an occasional arborescent specimen has been found at the Bully Hill, Afterthought and other mines. Fine crystallized specimens occurred in the old Excelsior mine, Copper City, Fairbanks[2].

10. COPPER.

Native copper, Cu.

Isometric. Good crystals rare. Generally in wires, thin sheets and arborescent crystallizations. No cleavage. Malleable and ductile. Luster metallic. Color copper-red. H=2.5—3; G=8.83.

Some metallic copper has been found in most of the copper mines of the State, but no deposits of the native metal are known. It is frequently mixed with cuprite and malachite in the oxidized zone of copper deposits, or found as coatings along the walls of copper veins, or in the vicinity of intrusive dikes, which have brought about a reduction of the

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ores. Most of the localities cited for chalcopyrite have yielded some native copper.

Alameda County: At the Alma pyrite mine on Leona Heights, east of Oakland, fine arborescent crystallizations of the native metal are occasionally found. The minerals of this mine have been described by Schaller[1].

Amador County: Arborescent masses occurred in the old Newton mine.

Calaveras County: Some of the mines along the copper-sulphide belt, especially at Copperopolis and at Campo Seco, have produced some of the mineral. At Mokelumne Hill it occurred associated with silver.

Colusa County: Found in serpentine with cuprite and melaconite at the Gray Eagle mine.

Del Norte County: Some large pieces have come from the Diamond Creek district and from the Pearl and Occidental mines.

El Dorado County: The old Cosumnes mine, near Fairplay, has yielded small masses of native copper with bornite, chalcocite and cuprite. The Alabaster Cave mine near Newcastle, the Cambrian mine near Placerville, the Ford mines near Georgetown and the Oest mine near Auburn, have had native copper with the cuprite.

Fresno County: Thin sheets have been found in quartz east of Fresno City.

Glenn County: Large float pieces have been found a few miles north of Chrome Mountain and also on Elk Creek.

Humboldt County: Many specimens occur on Red Cap and Boise creeks and also in the Horse Mountains.

Inyo County: The copper deposits in the Ubehebe Mountains contain the oxides of copper and some native copper.

Los Angeles County: At the Free Cuba mine, near Acton.

Mariposa County: Massive with malachite in the Copper Queen mine.

Mendocino County: Sheets and grains of metallic copper occur at Red Mountain, fifteen miles southeast of Ukiah. It is also seen in the serpentines in Lost Valley.

Merced County: Occurs with quartz and chalcopyrite in the Victor Bonanza mines.

Mono County: Found sparingly in the Lundy and Benton districts.

Placer County: At the Algol mine near Spenceville in sheets and hackly masses; at the Valley View mine, six miles from Lincoln; and near Todd on magnetite. Lindgren[4] reported it as one of the minerals of the Ophir district.

Plumas County: Found with rhodonite at Mumford's Hill. Large lumps occurred with cuprite, malachite and native silver in the old Pocohontas mine, Indian Valley.

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Riverside County: In the McCoy Mountain district.

San Luis Obispo County: At the Tiptop mine, ten miles north of San Luis Obispo, and on Chorro Creek in small pieces.

Shasta County: This is the principal copper county and many of the mines have produced specimens of arborescent copper and occasionally compact masses. The Bully Hill mines, Copper City mines, Shasta King mine, Mountain Copper mine, Mammoth mine, Balaklala mine and Kosk Creek mines may be mentioned.

Siskiyou County: Pieces have been found at Preston Peak with pyrite and chalcopyrite.

Tehama County: On Elder Creek and at White Bluff.

Tulare County: Masses have been found on the Middle Fork of the Tule River, about thirty miles east of Porterville.

11. MERCURY—Quicksilver.

Native mercury, Hg.

Liquid. Forms small fluid globules in the matrix which is usually cinnabar. Color tin-white. Brilliant metallic luster. G=13.59.

Liquid globules of mercury are common in most of the cinnabar mines, formed either by reduction of the sulphide or by sublimation of mercuric vapors. It prevails in deep workings and in those parts of ill-ventilated mines where intense heat is developed by the decomposition of iron sulphides. It is also frequently found near the walls of cinnabar veins. Most of the localities cited for cinnabar will serve for the metallic element.

Napa County: Frequent in the mines at Oak Hill and Knoxville. In the Wall Street mine it was abundant in the gravels.

San Benito County: In the cinnabar deposits at New Idria.

San Francisco County: Liquid globules have been found in silicious rock near Twin Peaks.

Santa Clara County: Very prevalent in some of the shafts at New Almaden.

12. LEAD.

Native lead, Pb.

Isometric. Crystals rare. Usually in small plates and pellets. Malleable. Color lead-gray. H=1.5; G=11.37.

Metallic lead is an exceedingly rare mineral and its reported occurrence as a true mineral is sometimes doubtful. Small bits of lead which are now and then found in the placer gravels may be portions of lead

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bullets, but the occurrence of the metal in deep placer mines is indicative of its origin as a natural reduction product.

Butte County: Some pieces of metallic lead found in a placer at Magalia were believed by Hanks[6] to be flattened bullets. Small angular fragments of native lead have been found at a prospect 14 miles east of Chico, on the West Fork of the Feather River, Rogers[5].

Kern County: Several pieces of metallic lead have been found in the dry washings at Goler.

Placer County: Small pellets of native lead have been found in a placer mine in North Ravine, in the Edgewood district, adjoining the Ophir district.

13. TIN.

Native tin, Sn.

Rounded grains. Color tin-white. Metallic luster. H=2; G=7.18.

Metallic tin is a rare mineral and there is some doubt regarding the origin of some of the small pieces found in the State.

Humboldt County: Bits of metallic tin have been observed in the sluices at Orleans.

Siskiyou County: Small pieces of tin have been found in the gravels at Sawyers Bar.

Tuolumne County: Several pieces of native tin were found in the sluices of the White Lead gravel claim, near Columbia.

14. ZINC.

Native zinc, Zn.

Hexagonal, rhombohedral. Crystals very rare. Color grayish white. Metallic luster. H=2; G=6.9—7.2.

A rare mineral, but of probable occurrence in the State.

Shasta County: Specimens of metallic zinc were found some years ago about five miles from Round Mountain and their occurrence was reported by Fairbanks[2]. The specimens are somewhat columnar in appearance and had some rock attached to them when found.

15. PLATINUM.

Native platinum, Pt.

Isometric. Generally occurs in grains and small nuggets. Malleable and ductile. Color light steel-gray. Metallic luster. H=4—4.5; G=14—19.

Gray metallic grains and small nuggets of platinum were early observed in some of the gold-bearing black sands of the streams and

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beaches, and also in the concentrates from the gold washings. Little attempt was made to save this precious metal, and it is only recently that any record has been kept of the production. It is rather a constant associate of the gold in most of the districts, and its origin lies doubtless in the serpentine rocks, in close association with the chromite. While it has a widespread occurrence in the State, it has not been detected as a constituent of any of the rocks, and unlike gold, it has never been found in place.

Analyses of California platinum have been made by Deville and Debray[1] and by Genth[1].

	Pt	Ir	Iridos	Pd	Rh	Fe	Cu	Au	SiO_2
Deville and Debray	85.50	1.05	1.10	0.60	1.00	6.75	1.40	0.80	2.95
Genth	90.24	2.42	0.68	some	some	6.66	---	---	---

Most of the platinum is alloyed with iridium, osmium, palladium and other metals of the platinum group, and much of it would be classed as platiniridium. Many of the black sands have been investigated by Day and Richards[1].

Butte County: It is a constituent of the black sands of Feather River and some of its tributaries, and the largest production is from the dredging operations at Oroville. It is present in the concentrates of Butte Creek, Brush Creek, Magalia, Cherokee, and Buchanan Hill.

Calaveras County: Observed in the concentrates at Douglas Flat and Mokelumne Hill.

Del Norte County: In the black sands at Crescent City, and along the Smith River.

Humboldt County: Early mentioned as one of the constituents of the gold-bearing beach sands at Gold Bluff. Found in the concentrates at Orleans, Trinidad, Wilson Creek and China Flat.

Inyo County: Said to have been found in the concentrates of the Mt. Hope mine, near Citrus.

Kern County: Traces of the metal have been observed in the sands at Kane Springs.

Mendocino County: In the beach sands near Little River.

Nevada County: In the concentrates of the Rough and Ready district and in considerable amounts at Relief Hill.

Placer County: In the black sands on the North Fork of American River, at Butcher, East Auburn, Blue Canyon, and Michigan Bluff.

Plumas County: In the concentrates at Genessee, La Porte and Rock Island Hill.

San Luis Obispo County: Observed in some of the beach sands.

Santa Barbara County: In the beach sands at Lompoc.

Santa Cruz County: In some of the beach sands of the county.

Shasta County: Found in the sands at Redding and on Cottonwood Creek.

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Siskiyou County: Observed in the sands at Callahan, Castella, Henley, Happy Camp, Sawyers Bar, Oak Bar, Fort Jones, Hornbrook, Cecilville, Klamath River, and Rock Ranch.

Tehama County: In the sands near Beegum.

Trinity County: Early observed as a constituent of the black sands of the Trinity River and its tributaries, and nuggets weighing several ounces have come from the county. Its presence has been shown in the sands at Douglas City, Burnt Ranch, Junction City, Big Bar, Hawkins Bar, and in the Hayfork district.

Ventura County: It has been observed in minute quantities in some of the beach sands.

Yuba County: Found in the concentrates at Indian Hill, Camptonville, and in the Brownsville district.

16. IRIDIUM.

Native iridium, Ir.

Isometric. Generally in grains. Color silver-white. Metallic luster. H=6—7; G=22.6—22.8.

Steel-gray grains of iridium have been detected with the platinum in some of the sands, but most of this metal is in alloy with platinum.

17. PLATINIRIDUM.

Native alloy of platinum and iridium, PtIr.

Isometric. Generally in grains and nuggets. Color light steel-gray. Metallic luster. H=6—7; G=22.65—22.84.

Much of the so-called platinum of the State is really this alloy, and several nuggets of a few ounces weight have been found along the Trinity River.

18. PALLADIUM.

Native palladium, Pd.

Isometric. Minute octahedrons. Generally in grains. Color light steel-gray. Malleable. H=4.5—5; G=11.3—11.8.

An associate of the platinum but in small amount. It is usually alloyed with platinum or iridium.

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19. IRIDOSMINE.

Native alloy of iridium and osmium, IrOs.

Hexagonal, rhombohedral. Generally in grains. Cleavage perfect basal. Color light steel-gray. Metallic luster. H=6—7; G=19.3—21.12.

This alloy is a frequent associate of the platinum and an analysis of it by Deville and Debray[1] shows the presence of the rarer metals, rubidium and ruthenium.

Ir	Rd	Ru	Os
53.50	2.60	0.50	43.40

Siserkite is a variety with not over 30 per cent iridium. According to Genth[1] the composition of some of the gray metallic grains is:

Siserkite	49.4 per cent
Platinum	48.4
Platiniridium	2.2
Palladium and rhodium	some

20. OSMIUM, RHODIUM and RUTHENIUM.

Rarer metals of the platinum group and generally found in alloy with the platinum or iridium.

21. IRON.

Native iron, Fe.

Isometric. Generally massive. Malleable. Color steel-gray to iron-black. Metallic luster. H=4—5; G=7.3—7.8. Strongly magnetic.

Iron occurs native either as telluric iron or as meteoric iron. Telluric iron is sometimes found in basaltic rocks, but its occurrence in this form is not known in the State. Meteoric iron has been found in at least four localities and analysed. Nickel is always present and sometimes cobalt, phosphorous, graphite or diamond.

El Dorado County: A meteorite weighing 85 pounds was found at Shingle Springs in 1871 and was analysed by Shepard[1].

Analysis:

Fe	Ni	Insol
88.02	8.88	3.50=100.40 per cent

Kern County: A meteorite found in the San Emidio Mountains in 1888 weighed about 80 pounds. It was unfortunately crushed before its identity was recognized and only fragments were saved. Merrill[1] described the material and it was analysed by Whitfield[2]. It was erroneously called the San Bernardino meteorite.

Analysis:

Fe	Ni	Co.
88.25	11.27	0.48=100 per cent

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San Bernardino County: An irregular-shaped mass of meteoric iron was found in the Ivanpah district in 1880 which weighed about 117 pounds. Analysed by Shepard[3] and by G. Gehring.

Analyses:

	SpG	Fe	Ni	Co	P	C	S	SiO_2	Graphite	
Shepard	7.65	94.98	4.52	--	0.07	0.10	--	--	--	=99.67
Gehring	8.076	94.86	4.47	0.26	tr.	0.12	tr.	0.04	0.07	=99.82

Trinity County: A small oval-shaped mass weighing 19 pounds was found at Canyon City about 1875. The surface was oxidized to limonite. Analysis of the purer portion was made by Shepard[4].

Analysis:

Fe	Ni	Co	P	
88.81	7.28	0.17	0.12	=96.38 per cent

22. AWARUITE.

Native alloy of nickel and iron, Ni_3Fe.

Isometric. Grains and nuggets. Tin-white to steel-gray color. Magnetic. H=5; G=8.1.

Del Norte County: Small grains of this alloy averaging 0.15 to 1.5 mm. in diameter were found in the residues from the gold washings of Smith River, associated with magnetite and chromite. Analysed by Jamieson[1].

Ni	Fe	Co	Cu	P	S	
76.69	21.37	1.20	0.04	0.04	0.06	G=7.85

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CHAPTER II.

SULPHIDES.

Semi-metals.
- Realgar
- Stibnite
- Bismuthinite

Metals.
- Molybdenite
- Argentite
- Galenite
- Chalcocite
- Stromeyerite
- Sphalerite
- Metacinnabarite
- Cinnabar
- Greenockite
- Covellite
- Millerite
- Pyrrhotite
- Bornite
- Cubanite
- Chalcopyrite
- Marcasite
- Pyrite

Oxisulphides.
- Kermesite
- Voltzite

23. REALGAR—Red Arsenic.

Sulphide of arsenic, AsS.

Monoclinic. Crystals common; also granular massive and incrustations. Color bright red to orange-yellow. Streak orange-yellow. Resinous luster. H=1.5—2; G=3.55.

Realgar is occasionally found with arsenical ores of silver, lead and copper, but it has been rarely seen in the State. The more stable sulphide, orpiment, has never been reported.

Alpine County: Specimens of deep red realgar coating pyrite, occurred in the Monitor mine, associated with minute white octahedrons of arsenolite.

San Bernardino County: Reported as occurring about forty miles from Needles, the locality being unknown.

Trinity County: A specimen was found in calcite in the northwestern part of the county.

24. STIBNITE—Antimonite.

Sulphide of antimony, Sb_2S_3.

Orthorhombic. Long prismatic crystals, often bent and curved and with faces striated and furrowed. Cleavage perfect brachypinacoidal. Color lead-gray. Streak dark gray. Metallic luster. H=2; G=4.52—4.62.

Stibnite is the common ore of antimony, and good deposits of the mineral exist in the State. It occurs generally as veins in granitic and metamorphic gneisses and schists. In gold and copper districts it is a common associate of the prevalent sulphides galena, sphalerite, chalcopyrite, pyrite and tetrahedrite, consequently may usually be found in those districts in small amounts. It is characteristically associated with cinnabar.

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Calaveras County: Observed with gold at Mokelumne Hill and in the Mother Lode region.

Inyo County: In the Cerro Gordo district considerable stibnite was found with the silver-lead ores, and some limonite specimens recently obtained from there are evident pseudomorphs after long prismatic stibnite crystals. Large bodies of the mineral are said to occur on the western slope of the Panamint Mountains, near Wild Rose Springs, associated with the oxide of antimony.

Kern County: The deposits in the San Emidio Mountains at the head of the San Emidio Canyon have long been known and were the first worked in the State. Veins of the mineral also are plentiful in the mountains in the northeastern part of the county. On Erskine Creek considerable native antimony has been found in association with the stibnite. Stibnite also occurs in the Caliente district.

Lake County: Some stibnite has been found with the cinnabar at Sulphur Bank, on Clear Lake.

Los Angeles County: Specimens have been found in the mountains south of Lancaster.

Mariposa County: Stibnite forms one of the sulphide minerals in the gold districts of the county.

Merced County: Fine specimens of prismatic stibnite have come from the McLeoud mining district.

Mono County: Very common in the Blind Springs district, associated with the silver-lead ores and good specimens have come from the Comanche, Comet and Diana mines.

Napa County: Fibrous bands of stibnite occurred with the cinnabar at the Manhattan and the Boston or old Redington mines, at Knoxville.

Riverside County: Bunches of stibnite were found at the Crowell mine, five miles southeast of South Riverside.

San Benito County: There are numerous veins of stibnite in the county, especially in the northeastern part, in close association with the cinnabar deposits. Fine crystallized specimens have come from the Ambrose, Alta and Shriver claims in the Antimony Mountains, northeast of Hollister, and some of the crystals have the forms: (010), (130), (110), (310), (210), (430), (113), (4.5.12), (102); Eakle[7].

San Bernardino County: In a boulder at the Centennial mine.

Santa Clara County: Large divergent columnar masses have come from near Gilroy. Stibnite is also an associate of the cinnabar at the New Almaden cinnabar mines.

Sierra County: Occurs as one of the sulphides with the gold ores at Downieville.

Tulare County: Found in the Mineral King district as an associate of argentiferous galena.

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25. BISMUTHINITE.

Sulphide of bismuth, Bi_2S_3.

Orthorhombic. Usually fibrous massive. Color lead-gray. Metallic luster. H=2; G=6.4 — 6.5.

The presence of bismuth has frequently been detected in the concentrates from several of the gold and copper districts but the form in which it occurs has not in general been determined. Bismuthinite as a distinct mineral has only been noticed in a few localities.

Fresno County: Some small pieces were found in Lot 1 mine and in the second Sierra mine, Kings River district.

Inyo County: Said to occur in some of the mines in the Kearsarge Mountains, near Independence.

Madera County: A constituent of the ores at Minarett Mountains, Turner[4].

Mono County: Found at Oasis with bismutite.

Riverside County: Found at the Lost Horse mine.

26. MOLYBDENITE.

Sulphide of molybdenum, MoS_2.

Hexagonal. Usually in scales and foliated masses. Cleavage perfect basal. Color light bluish lead-gray. Streak lead-gray, sometimes with greenish cast. H=1. — 1.5; G=4.7.

Molybdenite is the source of the molybdenum used in steel manufacture, for which there is some demand. The mineral is widely distributed in the State, occurring in small flakes and leaves in quartz and crystalline rocks. There are few places where it is segregated sufficiently to pay for its extraction. It strongly resembles graphite but can generally be distinguished from that mineral by its lighter bluish lead-gray color and its occurrence in quartz rather than in white limestone. In all counties having granitoid rocks some molybdenite can be found.

El Dorado County: Broad foliated plates occur at the old Cosumnes copper mine, near Fairplay, in a pegmatite vein with bornite, chalcopyrite, epidote, garnet, axinite, hornblende and orthoclase. Also in plates at Grizzly Flats.

Fresno County: In quartz at the Kings River Canyon copper mine.

Inyo County: In quartz on White Mountains. A thick ledge containing much molybdenite was reported on the west side of Death Valley.

Madera County: Plates were found in the Speckerman mine at Fresno Flat.

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Mariposa County: Specks of the mineral occur in a lens of garnet, epidote and quartz, on the southeast slope of Mount Hoffman, Turner[5] and at Knights Creek near Big Trees, Turner[4].

Mono County: Found with molybdite at Cameron near Bridgeport; in quartz at the Minnie mine, Sweetwater Range; at Silverado Creek with molybdite, Whiting[1].

Napa County: In quartz on Mt. St. Helena.

Nevada County: Abundant at Nevada City mixed with limonite, Genth[2]; good plates in the Mayflower mine, Nevada City; in the Excelsior mine, Meadow Lake district; in the rocks of Signal Peak; in a garnet-epidote rock near Lake Tahoe; broad plates in white quartz near Truckee.

Placer County: In a granodiorite with copper minerals at the Elder mine, about four miles west of Clipper Gap. Occurred in some of the mines of the Ophir district, Lindgren[4].

Plumas County: Broad plates occur in the Meadow Valley mining district.

San Diego County: Found in granite at Campo, with malachite and chalcopyrite at Potrero and in the Grapevine mining district.

Shasta County: In granite on Hazel Creek and also on Tom Neal Mountain, near Delta.

Tulare County: In plates at Three Rivers and in the Mineral King district.

Tuolumne County: In a quartz vein in granite on the south side of Knights Creek, northeast of Columbia; in a quartz vein with garnet, epidote, and sphalerite, about three miles west of Tower Peak, Turner[5].

Riverside County: Small flakes of molybdenite occur in thin pegmatite veins intersecting granite at a quarry about 4½ miles northeast of Corona.

27. ARGENTITE—Silver Glance.

Sulphide of silver, Ag_2S.

Isometric. Octahedral crystals, often distorted. Commonly in arborescent and reticulated shapes. Color dark lead-gray to black. Streak black. Metallic luster. Highly sectile. H=2—2.5; G=7.3.

Argentite is the primary silver mineral in many of the silver districts and is usually associated with other silver minerals such as cerargyrite, stephanite, polybasite and pyrargyrite, and with argentiferous galena. Silver is found with the gold and copper of the State, but there are few distinct silver districts.

Alpine County: One of the sulphides of the Silver Mountain district, and small octahedral crystals have come from the Advance mine.

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Inyo County: This is one of the few silver counties of the State and argentite has been quite common in some of the mines, especially at Cerro Gordo. Massive and crystal specimens have been prominent in the Oriental mine, Deep Spring Valley.

Kern County: Argentite crystals associated with native silver have been found in the Silver King mine, near Garlock. It occurs with tetrahedrite and pyrargyrite at the Amalie mine.

Los Angeles County: Was one of the silver minerals of the Kelsey mine, San Gabriel Canyon, associated with native silver, erythrite, smaltite, and annabergite. Also found at Silverado with argentiferous galena.

Mono County: Found sparingly in the Bodie and Benton districts with gold, tetrahedrite, sphalerite, chalcopyrite and galena. In the Sweetwater Range, north of Bridgeport, the mines contained argentite with gold, cerargyrite, tetrahedrite, native silver.

Nevada County: Mentioned by Lindgren[6] as occurring in the Allison Ranch mine, near Nevada City.

San Bernardino County: The silver districts of this county have produced some argentite, but in general the sulphide has not been prominent. The mines of the New York Mountains near Manvel show some, and also the old Imperial and Tiptop mines. Lava beds districts have produced crystals. It occurred to some extent with the hornsilver in the Calico and Barstow mining districts.

28. GALENITE—Galena.

Sulphide of lead, PbS.

Isometric. Cubes and cubooctahedrons common. Also massive, coarse and fine granular and sometimes lamellar and foliated. Cleavage perfect cubic. Color lead-gray. Streak dark gray. Metallic luster. H=2.5; G=7.43.

Galenite is a very common mineral and is usually prominent in all of the gold, silver and copper districts. It is found in large and small cubes and in granular and foliated masses. Much of it is argentiferous and forms the silver ore of the State. The characteristic associates are sphalerite, pyrite, tetrahedrite, chalcopyrite, barite, fluorite and calcite. Its two common alteration products, cerussite and anglesite, very often accompany it.

Alpine County: It occurs argentiferous in the Silver Mountain district.

Amador County: Very often found in the mines near Plymouth and along the Mother Lode.

Calaveras County: On Carson Hill, at Angels and in many of the mines of the Mother Lode.

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El Dorado County: A sulphide constituent of many of the mines of the county. Common in cubes at Grizzly Flats.

Inyo County: Argentiferous galena has been the important silver ore of the county. At the old Modoc, San Felipe, Defiance, and other mines of the Cerro Gordo district it formed the chief silver ore. Common also in the Panamint Range and fine crystals have come from the Blue Wing mine.

Kern County: Occurs in the mines near Garlock and in the Amalie district.

Los Angeles County: The Kelsey mine in the San Gabriel Canyon contained some galena. A small deposit occurred on Santa Catalina Island which carried a little silver and some sphalerite and chalcopyrite.

Madera County: Large cubes have come from the Star mine, Mount Raymond district.

Mariposa County: Mines near Bagby and Coulterville show galena and it is a frequent sulphide constituent of the gold-bearing veins.

Mono County: This is one of the silver-lead counties and argentiferous galena forms important bodies of ore. It is very common in the Bodie, Benton and Lundy districts and at the claims on the Sweetwater Range.

Nevada County: Found in the Meadow Lake and other mining districts of the county. Mentioned by Lindgren[6] as one of the minerals of the mines at Grass Valley and Nevada City.

Orange County: Argentiferous galena occurs near Elsinore and in the Silverado district.

Plumas County: Occurs in the Meadow Valley and Light's Canyon districts.

Sacramento County: At Michigan Bar with sphalerite and pyrite, Hanks[6].

San Bernardino County: Argentiferous galena with lead carbonate was common in several of the silver districts of the county. Common in the Silver Mountain, Silver Reef, and to some extent in the Calico and Barstow districts.

Shasta County: It is present although not in abundance at most of the copper mines.

Siskiyou County: Occurs in deposits near Callahan, carrying some silver.

Tehama County: On Cow Creek, Hanks[6].

Tulare County: Prominent in the Mineral King district.

Tuolumne County: At the Soulsby mine, and to some extent with pyrite and sphalerite in the mines on Quartz Mountain and Whiskey Hill.

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29. CHALCOCITE—Copper Glance—Redruthite.

Sulphide of copper, Cu_2S.

Orthorhombic. Crystals with deeply striated faces. Generally compact massive. Color dark lead-gray to black. Streak black. Metallic luster. H=2.5—3; G=5.70.

Massive specimens of the dark gray chalcocite are common in many of the copper claims of the State, but large bodies of this valuable copper mineral are rare. The mineral is formed in the lower levels through the secondary enrichment of the copper-iron sulphides by solutions charged with copper obtained from the upper zones of oxidation. Bornite and chalcopyrite are often intermixed with the chalcocite, and malachite commonly coats the surfaces of specimens.

Alpine County: Probably the first copper claim in the State was the Uncle Billy Roger's claim in Hope Valley, in the northwestern corner of the county. The claim was described as a chimney-shaped deposit in a garnet rock which carried some chalcopyrite, pyrite and chalcocite.

Calaveras County: Small amounts of massive chalcocite have been found in the copper deposits at Campo Seco and Copperopolis.

Occurred also on Quail Hill, Silliman[5].

Del Norte County: Massive chalcocite occurred in the Copper Creek, Diamond Creek and Crescent City mines.

El Dorado County: In the old Cosumnes copper mine near Fairplay it was associated with bornite and chalcopyrite.

Humboldt County: Said to occur in the Horse Mountain district.

Inyo County: There are numerous copper claims in this county and good specimens of the massive chalcocite have come from the Ubehebe Mountains.

Los Angeles County: Occurred in the mines at La Soledad Pass.

Madera County: Found in the old Buchanan mine.

Mariposa County: Occurred in small amounts in some of the claims near Coulterville.

Placer County: Said to have occurred in the Baker mine near Lincoln.

Plumas County: Rich copper ore consisting of chalcocite and bornite is found in the Gennessee Valley and Light's Canyon districts.

San Benito County: Small grains of chalcocite occur in the natrolite with the benitoite of this county, Louderback[2].

San Bernardino County: Some of the copper claims in the mountains in the eastern part of the county contain rich masses of copper glance.

Good specimens have come from the Silver Prize, Copper World, Francis, Arabella, Florence and Hettie mines.

San Diego County: Found at Potrero.

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Shasta County: Some chalcocite has been found in most of the copper mines of the county, but the mineral is not prominent in any of them. Specimens have come from the Mountain Copper, Balaklala, Afterthought, Bully Hill and Copper City mines.

Tuolumne County: Occurred in the Whiskey Hill mines, Silliman[5].

30. STROMEYERITE.

Sulphide of silver and copper, $(Ag, Cu)_2S$.

Orthorhombic. Generally compact massive. Color and streak dark steel-gray. Metallic luster. H=2.5—3; G=6.15—6.3.

This mineral has only been found in silver districts where copper is also present. It is formed in the same way as chalcocite and may grade into it.

Alpine County: Believed to be a part of the ore in the Monitor and Mogul districts, associated with galena, sphalerite, pyrite and enargite.

Inyo County: The Silver Queen and other mines of the Panamint Mountains contained the mineral with tetrahedrite and cerargyrite. Found also in the Cerro Gordo and Wild Rose districts.

Riverside County: Probably present in the Homestake copper mine in the Palen Mountains.

San Bernardino County: It occurred as one of the numerous minerals of the Calico district and an analysis of it from the Silver King mine was made by Melville and Lindgren[1].

Ag	Cu	Fe	S	Res = $BaSO_4 + SiO_2$
53.96	28.58	0.26	15.51	1.55=99.86 per cent. Sp. G=6.28

31. SPHALERITE—Zincblende—Black Jack.

Sulphide of zinc, ZnS.

Isometric, tetrahedral. Imperfect crystals, granular and massive. Cleavage perfect dodecahedral. Color yellow, brown and black. Streak colorless to yellowish brown. Resinous luster. H=3.5—4; G=4.0.

Sphalerite is a very common sulphide and is very prevalent in most of the mining regions. It occurs from clear light brown to very dark brown, almost black masses. Its typical associate is galena, but it is also often intimately mixed with pyrite, chalcopyrite, tetrahedrite, arsenopyrite and lead-silver minerals. In the smelting of zinc-bearing ores few of the smelters have endeavored to save the zinc.

Alpine County: Occurred as one of the minerals in the Rogers claim, Hope Valley.

Calaveras County: Common in the pyrite ore at Campo Seco and Copperopolis.

El Dorado County: One of the sulphides in the mines at Grizzly Flats, Pilot Hill and other mines of the county.

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Inyo County: Common as an associate with galena in the Darwin, Cerro Gordo and Inyo Mountain mines.

Los Angeles County: With galena and chalcopyrite on Santa Catalina Island.

Mariposa County: Occurs in the mines along the Mother Lode. A light brown tribo-luminescent variety mixed with white barite and gray tetrahedrite, the ore resembling a dark gray schist, was found at the Fitch mine and was described by Eakle[5] and Eakle and Sharwood[1]. The sphalerite emits a peculiar train of light when scratched or rubbed.

Mono County: Occurs in the Homer, Lundy and Benton districts.

Nevada County: Occurs in many of the gold mines of this county. Prominent in the Meadow Lake district and in the mines of Grass Valley and Nevada City.

Placer County: One of the associate minerals in the gold deposit at Ophir.

Plumas County: The mines of the Meadow Valley, Indian Valley and Light's Canyon contain some sphalerite with the other sulphides.

Sacramento County: At Michigan Bar with galena.

San Bernardino County: In this county zincblende is found to some extent with the silver-lead sulphides. Specimens have come from the Silver Reef, Calico, Grapevine and Lava Beds districts.

Shasta County: Masses of sphalerite occur in the Afterthought and Peck mines and to some extent in the Bully Hill, Copper City, Iron Mountain and other districts of the county.

Siskiyou County: Common with galena and chalcopyrite at Callahan.

Tulare County: Common in the Mineral King district.

Tuolumne County: Massive at the Soulsby mine and sparingly in the mines along the Mother Lode.

32. METACINNABARITE.

Sulphide of mercury, HgS.

Isometric, tetrahedral. Usually massive and amorphous. Color grayish black. Streak black. Metallic luster. H=3; G=7.81.

The black sulphide of mercury was discovered in 1872 at the old Redington mine, Knoxville, and since its discovery has been found in many of the cinnabar deposits of the State.

Colusa County: Found in the Sulphur Creek district at the Manzanita mine with cinnabar and gold.

Inyo County: Occurred in the Cerro Gordo mine and was analysed by Melville and Lindgren[1].

HgS	$FeS+SiO_2$
95.62	4.38

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Lake County: Prominent in the Great Western, Baker and Abbott mines.

Monterey County: With the cinnabar in the Parkfield district.

Napa County: Discovered in the Redington, later Boston mine, which is now abandoned. It occurred in black amorphous-like masses and was described as a new mineral by Moore[1]. Good crystals were later found in the same mine which showed the mineral to be isometric instead of amorphous, Penfield[1]. Forms: (111), (211), (322), (975). Analyses of the mineral from this mine were made by Moore[1] and also by Melville and Lindgren[1].

	S	Hg	Fe	SiO_2	
Moore	13.82	85.79	0.39	0.25	=100.25 per cent
	HgS	FeS	SiO_2		
M. and L.	99.48	0.69	0.71		= 99.88 per cent
	98.48	0.94	0.71		=100.13

The old Reed mine contained considerable metacinnabarite. In the Oat Hill mine specimens were found coated with white calomel.

Orange County: Found on the San Joaquin Ranch disseminated through a ferruginous barite; analysed by Genth[8].

Hg	S	Cl	
85.89	13.69	0.32	=99.90 per cent

San Benito County: Large pieces have been found at the New Idria mine. Found also at the Picachos mine in black masses, Rogers[5].

San Luis Obispo County: In the Adalaide and Oceanic districts it has been occasionally found.

Santa Clara County: Considerable amounts have been found in the New Almaden and Guadalupe mines. Melville and Lindgren[1] analysed the mineral from the New Almaden mine and described the crystals as hexagonal, with some complex and doubtful forms: (0001), $(05\bar{5}4)$, $(1\bar{1}01)$, $(1\bar{3}22)$, $(50.\bar{5}0.0.1)$, $(48.\bar{4}6.\bar{2}.\bar{1})$, $(41.\bar{3}8.\bar{3}.\bar{1})$.

Analysis:

S	Hg	Fe	Co	Zn	Mn	$CaCO_3$	SiO_2	Vol. org. matter	
13.68	78.01	0.61	tr.	0.90	0.15	0.71	4.27	0.63	=99.26 per cent

Yolo County: Found in the California mine.

33. CINNABAR.

Sulphide of mercury, HgS.

Hexagonal, rhombohedral. Small crystals common. Also granular massive. Cleavage perfect prismatic. Color cochineal-red. Streak scarlet-red. Adamantine luster. H=2—2.5; G=8.0.

Cinnabar was known in the State long prior to the discovery of gold, and the old mine at New Almaden had been in active operation for some time when Lyman[3] described a visit to it in 1848. The most important

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deposits lie in the Coast Ranges extending from Del Norte County to San Diego County, those in the Sierras being of minor value. The most important counties in the production of quicksilver have been Lake, Napa, Santa Clara and San Benito counties and many flasks of mercury have come from once famous mines which are now idle or exhausted. The deposits in general occur along the contact between serpentine and metamorphic sandstones and shales, and the mineral has been deposited from solfataric waters carrying the sulphide in solution. These solutions have impregnated the sandstones and brecciated masses of opal and chalcedony which have formed in the serpentine through much silicification, leaving seams and pockets of cinnabar. The impregnations have followed flows and intrusions of igneous rock in the immediate neighborhood. Becker[1] and Aubury[2] have issued general reports on the quicksilver deposits of California.

Alameda County: Streaks of cinnabar occur in a chalcedonic mass in the Cragmont district, North Berkeley.

Colusa County: Deposits occur on both sides of Sulphur Creek in sandstones and shales, associated with sulphur, bitumen and gold. The Manzanita, Elgin, Empire and Wide Awake mines were former producers.

Del Norte County: Cinnabar is found in the northern part of the county in the Diamond Creek district.

El Dorado County: The Bernard or old Amador quicksilver mine has produced some of the mineral.

Fresno County: Cinnabar claims exist in the Little Panoche district on the Gabilan Range and on Cantua Creek.

Inyo County: Small amounts of cinnabar occurred at the Cerro Gordo mines.

Kings County: Small deposits of the mineral exist on Table Mountain in the southern part of the county.

Lake County: The important and interesting deposit of cinnabar at Sulphur Bank on the shore of Clear Lake has been described at length by Becker[1] and by Le Conte and Rising[1]. Cinnabar is at present in process of formation in the porous disintegrated basalt which outcrops on the lake. They are characteristically long hexagonal prisms capped by the low rhombohedron $(20\bar{2}3)$. Melville and Lindgren[1] gave the forms $(30\bar{3}4)$ and $(03\bar{3}4)$. The Great Western near Middletown, and other mines of the county were once famous producers, but practically all of the mines of the county have been idle for some years.

Mariposa County: Crystals of cinnabar are said to have occurred near Coulterville associated with gold.

Merced County: Small deposits occur on the dividing line of San Benito County.

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Mono County: Small amounts of cinnabar have been found about five miles northeast of Bodie.

Monterey County: Some of the deposits on Table Mountain near Parkfield are in this county.

Napa County: This county has long been an important producer of mercury, the mine at Oat Hill being the last in active operation. The cinnabar is found impregnating unaltered sandstone. The abandoned old Redington or Boston mine at Knoxville is famous for the rare and new minerals found with the cinnabar. Much of the cinnabar of this region impregnates shattered chalcedony masses in the serpentine, as at the Manhattan mine, and some impregnates the serpentine. Crystals from the Boston mine, according to Melville and Lindgren[1] have the forms $(04\bar{4}5)$ and $10\bar{1}0)$.

Deposits of the Pope Valley and at Vallejo have also been important.

Nevada County: Found in association with gold at Grass Valley, W. P. Blake[9], Lindgren[6].

Orange County: A small deposit on San Joaquin Ranch.

San Benito County: The mines in the New Idria district, in the southern part of the county, are at present the most productive in the State. The cinnabar solutions have impregnated the sandstones and to some extent the serpentines near the contact of the two. The New Idria mine is the most important one of the district. Smaller deposits of the mineral also occur near the center of the county and in the extreme northeastern part of the county. Melville and Lindgren[1] describe crystals from the New Idria mine with the forms: (0001), $(02\bar{2}3)$, $(01\bar{1}2)$, $(01\bar{1}1)$, $(20\bar{2}3)$, $(10\bar{1}2)$, $(10\bar{1}0)$, $(6.4.\bar{1}0.25)$, $(5.2.\bar{7}.18)$, $(105.60.\bar{1}6\bar{5}.407)$, $(63.27.\bar{9}0.230)$, $(40.15.\bar{5}\bar{5}.143)$, $(26.12.\bar{3}\bar{8}.95)$.

San Francisco County: Small streaks of cinnabar occur on Twin Peaks.

San Luis Obispo County: The productive mines occur in the Santa Lucia Range, and comprise several districts of which the Oceanic and Adelaide are the most important. The ore impregnates the Franciscan sandstones and shales and also chalcedonic masses in the serpentine. There are numerous other small deposits in outlying districts.

Santa Barbara County: Some cinnabar occurs in the Santa Ynez Range and near the Cachuma Creek, but no deposits are now worked.

Santa Clara County: The New Almaden mine is the oldest quicksilver mine in the State. It has been a famous producer and is still being worked. The cinnabar of the district occurs impregnating in streaks the opal-like masses of silica formed by the alteration of the serpentine. Melville and Lindgren[1] described crystals from the mine with forms: (0001), $(01\bar{1}2)$, $(02\bar{2}3)$, $(02\bar{2}1)$, $(10\bar{1}0)$, $(0.14.\bar{1}\bar{4}.5)$.

The Guadalupe and other mines of this locality have also been important producers of the metal.

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Shasta County: Some cinnabar is found about 30 miles northeast of Redding.

Siskiyou County: Deposits occur near Oak Bar, which have been worked slightly.

Solano County: The old St. John mine, in a basin between Mount Luffman and Mount St. John, was a good producer in the early days of cinnabar mining.

Sonoma County: Most of the mines which were once productive occur in the Mayacmas district, along the Mayacmas range. This region has been the scene of great volcanic activity and the cinnabar has followed these eruptions and impregnated the sandstones, serpentines and metamorphosed sedimentaries which lie on the flanks of the range.

Stanislaus County: The cinnabar deposits occur on Red Mountain on the border of Santa Clara County.

Trinity County: The old Altoona and other claims in the northern part of the county, near Cinnabar and Carrville, were once productive.

Yolo County: The deposits of this county are in the continuation of the Knoxville district.

34. GREENOCKITE.

Sulphide of cadmium, CdS.

Hexagonal. Generally as thin coatings. Color lemon-yellow. Resinous luster. H=3—3.5; G=4.9—5.0.

A very rare mineral found coating sphalerite occasionally.

Mono County: Thin coatings of yellow greenockite occur on magnetite and sphalerite near Topaz.

Riverside County: Thin coatings of yellow cadmium sulphide were found on sphalerite at the cement quarry at Crestmore.

35. COVELLITE—Blue Copper.

Sulphide of copper, CuS.

Hexagonal. Commonly massive. Cleavage basal. Color indigo-blue. Streak grayish black. Metallic luster. H=1.5—2; G=4.59—4.63.

Covellite is a much rarer form of copper sulphide than chalcocite and it has only been found as an occasional specimen. It is usually associated with bornite, chalcocite or chalcopyrite.

Calaveras County: Specimens have been found at the Satellite mine near Campo Seco.

Inyo County: Specimens have come from the Ubehebe Mountains.

Madera County: Found at the old Pocahontas mine.

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Mariposa County: Small amounts have been found in the Copper Queen mine, near Mariposa.

Shasta County: Some covellite occurs in the Balaklala mine, and at the Bully Hill mine as an alteration of chalcopyrite.

36. MILLERITE—Capillary Pyrites.

Sulphide of nickel, NiS.

Hexagonal, rhombohedral. Usually in long slender needles and hair-like tufts. Cleavage perfect prismatic. Color brass-yellow. Streak greenish black. Metallic luster. H=3 — 3.5; G=5.65.

Nickel minerals are quite rare in the State and their occurrence has been limited to the discovery of occasional specimens. Some needles of millerite have been found in the cinnabar districts, and rarely with gold.

Calaveras County: Long divergent prisms were found in white albite at the Stanislaus mine on Carson Hill, which Jackson[3] thought to be elongated cubes of pyrite.

Humboldt County: Specimens of serpentine from this county occasionally contain needles of millerite.

Napa County: Small coatings of capillary millerite were found with cinnabar at the Andalusia mine near Knoxville; also at the Oat Hill mine and in Pope Valley. Specimens of serpentine have come from Beryessa Valley containing needles of millerite.

Placer County: Found with arsenopyrite near Cisco, Hanks[6].

Plumas County: Millerite as coatings occurred in the Pocahontas mine, Mount Meadow district.

37. PYRRHOTITE—Magnetic Pyrites.

Sulphide of iron, Fe_nS_{n+1}.

Hexagonal. Crystals rare. Commonly massive, either granular or compact. Color bronze-brown. Streak grayish black. Metallic luster. Usually slightly magnetic. H=3.5 — 4.5; G=4.58 — 4.64.

The bronze-brown pyrrhotite is often associated with pyrite and sometimes is found in large lenticular masses. It is a common sulphide in gold and copper districts, although generally in small amounts. Masses of it occur in serpentine and in pegmatite veins. It is sometimes nickeliferous.

Calaveras County: Occasionally found with the pyrite at Campo Seco and at Copperopolis.

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Del Norte County: The copper claims in the northern part of the county on Diamond Creek, Copper Creek and Shelly Creek contain pyrrhotite with chalcopyrite.

Fresno County: Large bodies are said to occur on the Fresno Copper Company's property.

Humboldt County: Bodies are said to exist on Elk Creek.

Madera County: Found in the old Buchanan mine, Turner[4].

Marin County: Tabular crystals have been found on Mount Tamalpais.

Mariposa County: Thick bodies occur in the Green Mountain mine. The mineral is common as one of the sulphides of the gold mines.

Mono County: Common in quartz at the Tioga mine, Turner[2].

Nevada County: Found in the mines of Grass Valley and Nevada City, Lindgren[6]. Also in the Meadow Lake district, Lindgren[5].

Placer County: One of the sulphides of the Ophir mine, Lindgren[4].

Shasta County: Found with the pyrite at some of the copper mines and noticed at the Black Diamond copper mine.

Siskiyou County: Prominent with chalcopyrite at Callahan. Said to be nickeliferous at the Hummer mine.

Tuolumne County: In gneiss on north fork of Beaver River, Turner[8].

38. BORNITE—Erubescite—Peacock Ore.

Sulphide of copper and iron, Cu_3FeS_3.

Isometric. Crystals very rare. Generally compact massive. Color reddish brown, generally tarnished to iridescent colors. Streak grayish black. Metallic luster. H=3; G=4.9—5.4.

Bornite is generally associated with chalcocite and chalcopyrite, and is frequently found in small masses in many of the copper districts. It is sometimes formed along contact zones with garnet, epidote, vesuvianite and other contact minerals. The reddish brown color and characteristic tarnish to peacock colors readily distinguishes bornite from grayish black chalcocite and brass-yellow chalcopyrite.

Calaveras County: Small masses have been found at Campo Seco and Copperopolis.

Del Norte County: Common in the mines at the head of Copper Creek.

El Dorado County: At Slug Gulch with chalcopyrite and massive green epidote.

In the old Cosumnes copper mine near Fairplay, massive bornite occurred in coarse pegmatite of orthoclase, hornblende, epidote, garnet and molybdenite. Found at Georgetown with massive garnet.

Small amounts found in the Alabaster Cave mine near Newhall.

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Inyo County: Found in some of the mines of the Inyo and Ubehebe Mountains.

Los Angeles County: Found in the Meadow Valley district with fine crystals of garnet.

Mono County: Occurred in the Tioga mine and in the Benton district.

Plumas County: Massive bornite is a common form of copper in Light's Canyon, Genessee Valley and Indian Valley.

San Bernardino County: Bornite occurs at the Tiptop mine, Lava Beds district.

Santa Clara County: Near Lexington, Hanks[6].

Shasta County: Bornite is occasionally found in the copper mines of this county and specimens have come from Bully Hill, Copper City, Afterthought and Iron Mountain.

39. CUBANITE.

Sulphide of copper and iron, $CuFe_2S_4$.

Isometric. Generally massive. Color bronze-yellow. Streak black. Metallic luster. H=4; G=4.

Cubanite is a rare mineral and it needs careful analyses to substantiate its occurrence.

El Dorado County: Specimens have come from some locality in this county.

San Luis Obispo County: A large mass of this mineral was found on Santa Rosa Creek near San Simeon, Hanks[6]. The specimens have a bronze-yellow color and are compact massive.

40. CHALCOPYRITE—Copper Pyrites.

Sulphide of copper and iron, $CuFeS_2$.

Tetragonal. Generally massive. Color deep brass-yellow, often with iridescent tarnish. Streak greenish black. Metallic luster. H=3.5—4; G=4.1—4.3.

Chalcopyrite is the commonest of the copper minerals and forms the principal source of copper in the State. The copper deposits are largely bodies of pyrite in which chalcopyrite is intermingled, forming in general low grade copper ore with some gold and silver. The ore bodies usually occur in shear zones and belts of metamorphic rock and their origin has been due to solutions carrying the sulphides and impregnating the crystalline schists, and occasionally the country rock, the impregnations following flows and intrusions of igneous rock. Where conditions have been favorable the pyrite has become segregated into

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large masses with often more or less lenticular shape. Deposits along the contact between limestone and igneous rock are common. The common associated minerals with the pyrite and chalcopyrite are galena and sphalerite and occasionally stibnite, bismuthinite and tetrahedrite. Besides quartz, calcite and barite are often present as gangue minerals. Most of the deposits have a gossan capping of earthy limonite and hematite resulting from the oxidation of the iron sulphides. Practically all of the large bodies of pyrite in the State carry some chalcopyrite, but those in Shasta and Calaveras counties are at present the most important in the production of copper. Chalcopyrite in small patches and seams has a wide distribution and in consequence of its alteration green stains and coatings of copper carbonate are very common. Aubury[1] has issued a general report on the copper resources of the State and some of the data regarding localities is incorporated below.

Alameda County: A body of pyrite containing a small amount of chalcopyrite is mined at Leona Heights, East Oakland, for sulphuric acid. The ore lies between serpentine and altered volcanic rock and the alteration minerals have been described by Schaller[1].

Alpine County: The oldest copper claim in the State was the Uncle Billy Rogers claim in Hope Valley. This claim located in 1855 consisted of chalcopyrite, pyrite and bornite in a chimney-shaped deposit in garnet rock. Some chalcopyrite occurs with the pyrite and enargite in the Mogul district.

Amador County: In the foothills in the western part of the county there is a belt of hornblende and chlorite schists which contain frequent lenticular masses of pyrite with chalcopyrite and many claims are located along the belt. The old Newton mine near Ranlett, claims near Jackson and those of Copper Hill are well known.

Calaveras County: The belt of schists in the western part of the county contain important deposits and the mines at Copperopolis and at Campo Seco are still important producers of copper.

Del Norte County: Deposits of chalcopyrite with pyrite and pyrrhotite occur in the serpentine area of the northern portion of the county near Smith River and its tributaries. Low Divide, Diamond Creek and Shelly Creek are some localities.

El Dorado County: There are numerous small deposits of the mineral in scattered areas in the county, but none of great importance. The mineral is found near Diamond Springs, near Georgetown and at Pilot Hill in the northwestern part of the county. Good specimens of chalcopyrite with bornite, molybdenite, garnet, epidote and axinite have come from the old Cosumnes copper mine on the Amador County line.

Fresno County: Chalcopyrite occurs with pyrrhotite at the Fresno copper mines, with pyrite at the Copper King mine, and in the gold district of the northeast part of the county.

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Humboldt County: Deposits occur on the east slope of Horse Mountain with chalcocite, native copper and cuprite.

Inyo County: Chalcopyrite occurs near Darwin on contact between granite and limestone and in the Ubehebe Mountains with chalcocite.

Imperial County: In the extreme eastern part of the county the copper claims near Ogilby, Hedges and in the Picacho district contain some chalcopyrite with oxidized ores.

Kern County: Chalcopyrite with pyrite occurs in the gold mines of the eastern part of the county near Randsburg and Garlock.

Madera County: The belt of schists carrying the copper and iron sulphides extend across the county and there are numerous small claims. Found in small masses in the Green Mountains, at the old Buchanan mine, at the Ne Plus Ultra and other claims near Daulton.

Marin County: Small deposits of pyrite mixed with chalcopyrite occur in the schists between Mount Tamalpais and Bolinas Bay.

Mariposa County: Chalcopyrite is present to some extent in the gold mines of the county. Several small bodies of the sulphides occur in the schists and altered diabases on the western border but of little importance. The Green Mountains and other mines on the south border near Donovan, the old Pocahontas mine near Lewis, the Copper Hill mines in Indian Gulch, the old Beretta mines and other claims near the Merced River, all contain massive chalcopyrite with auriferous pyrite.

Nevada County: At Spenceville, Mineral Hill, Pine Hill, Iron Mountain, French Corral and North San Juan chalcopyrite claims have been worked. Good masses of pure chalcopyrite also are found in the Meadow Lake district.

Placer County: Near Auburn, Newcastle, Valley View and at Dairy Farm good deposits of pyrite with some chalcopyrite occur.

Plumas County: Deposits of good chalcopyrite with bornite and chalcocite are found in Genessee Valley near Flournoy, in Indian Valley near Taylorsville and in Moonlight and Light's canyons about twelve miles north of Taylorsville.

Riverside County: The copper deposits lie mostly in the eastern part of the county in the Palen, McCoy and other mountains.

San Bernardino County: There are numerous gold-copper claims in the county especially in the mountains of the eastern part. Some chalcopyrite occurs with oxidized copper ores in the Clarke Mountains, New York Mountains, near Ivanpah, Manvel, Vontrigger, Sunrise, Needles, on Mount Whipple, Monument Mountain, Turtle Mountain and Providence Mountains. The mineral is also found in the Lava Beds district, in the Oro Grande district and in the Morrow district north of Barstow.

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San Diego County: Masses of chalcopyrite occur in the Encinitas group of mines, a few miles east of Encinitas and in the Banna mines near Lakeside. Some is found in the Julian district.

Shasta County: The deposits of this county are the most important and most extensively worked in the State. The ore is pyrite carrying the copper sulphide and while in general low-grade copper propositions, the immense size of the bodies makes them of great value. The Iron Mountain, or Mountain Copper, Shasta King, Balaklala, Golinsky, Mammoth and other mines on the west side of the Sacramento River, and the Afterthought, Copper City and Bully Hill mines on the east side of the river have been great producers of copper for some years. The ore bodies in general lie in shear zones in metarhyolite or meta basalt, and sometimes along the contact of the igneous rock and limestone.

Sierra County: Small masses of chalcopyrite with other sulphides occur near Poker Flat, Sierra City and in the Mohawk Valley.

Siskiyou County: The Richie mine and claims near Callahan show chalcopyrite.

Trinity County: Some deposits of the mineral occur in the western part of the county along New River, at the mouth of Rattlesnake Creek and on the Cold Fork of Indian Valley Creek.

Tulare County: Chalcopyrite with pyrite is found on the middle fork of Tule River, a few miles east of Porterville and also near Kearsarge Peak.

Tuolumne County: The schist belt carrying the sulphides crosses the county a few miles west of the Mother Lode and several small claims are located along the belt.

41. MARCASITE—White Pyrites.

Sulphide of iron, FeS_2.

Orthorhombic. Commonly in tabular crystals, stalactites. Also massive and indistinguishable from pyrite. Color pale brass-yellow. Streak brownish black. Metallic luster. H=6—6.5; G=4.85—4.9.

Marcasite can not readily be distinguished from pyrite except when in crystals, so it is often classed as pyrite. It is much rarer in the State than pyrite, and is rather characteristically associated with clays and cinnabar.

Alpine County: Specimens associated with sphalerite have come from some of the mines of the county.

Napa County: Marcasite was the abundant iron sulphide at the old Redington mine, Knoxville, in close association with the cinnabar.

Nevada County: Mentioned as one of the minerals of the Grass Valley mines by Lindgren[6].

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42. PYRITE—Iron Pyrites.

Sulphide of iron, FeS_2.

Isometric. Crystals common; usually cubes, pyritohedrons and octahedrons. Generally compact and granular massive. Color brass-yellow. Streak greenish black. Metallic luster. H=6—6.5; G=5.

Pyrite is the commonest of the sulphide minerals and is found in all kinds of rock, but is more especially prominent in metamorphic schists, slates and quartzites and in unaltered sandstones. It is commonly found in distinct crystals and in granular masses. Cubes several inches in diameter are frequent in gold districts, but in general the smaller crystals and granular masses are more highly auriferous. It is from pyrite bodies that most of the copper production of the State is obtained, the source of the copper being the intimately intermingled chalcopyrite. All of the localities given for chalcopyrite and many more might be cited for the mineral since it is present in every county. Its oxidation produces limonite and hematite and the gossan of mineral veins is mostly formed by its alteration. Cubes of limonite as pseudomorphs after pyrite are exceedingly common.

Alameda County: Crystals from the Alma mine, Leona Heights, have the forms: (110), (100), (340), (120), (140), (111), (252), (121), (241), (231), Schaller[1].

Calaveras County: Cubes and pyritohedrons occur with the gold on Carson Hill, but the long needles from the Stanislaus mine, described as distorted pyrite crystals by Jackson[3], are millerite.

Colusa County: Hexagonal plates of pyrite occur as pseudomorphs after pyrrhotite at the Sulphur Creek deposit, Genth[7].

Santa Clara County: Crystals from the New Almaden cinnabar mine had the forms: (100) and (470), Jackson [3].

Sonoma County: Large octahedrons have been found on Austin Creek near Healdsburg.

43. KERMESITE—Red Antimony.

Oxisulphide of antimony, Sb_2S_2O.

Monoclinic. Usually in hair-like tufts. Color cherry-red. Streak brownish red. Metallic to adamantine luster. H=1—1.5; G=4.5.

This is a rare mineral formed by the oxidation of minerals containing antimony, especially stibnite. It is generally in cavities as long cherry-red needles.

Kern County: Fine red needles of kermesite were found on stibnite at the Mojave antimony mine, about fifteen miles north of Mojave.

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44. VOLTZITE.

Oxisulphide of zinc, Zn_5S_4O.

Globular and lamellar forms. Color rose-red to brown. Streak brownish red. Vitreous luster. H = 4 — 4.5; G = 3.66 — 3.8.

A very rare mineral which forms globular and platy reddish brown coatings from the oxidation of zinc sulphide.

San Bernardino County: Specimens have come from some place in this county.

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CHAPTER III.

ARSENIDES, SELENIDES, TELLURIDES AND SULPHOSALTS.

Arsenides.
Cobaltite
Arsenopyrite
Smaltite
Löllingite
Leucopyrite
Selenides.
Tiemannite

Tellurides.
Tetradymite
Hessite
Petzite
Altaite
Coloradoite
Melonite
Sylvanite
Calaverite
Nagyagite

Sulphantimonites.
Berthierite
Jamesonite
Bournonite
Pyrargyrite
Tetrahedrite
Geocronite
Stephanite
Polybasite
Sulpharsenites.
Dufrenoysite
Proustite
Enargite

45. COBALTITE.

Sulpharsenide of cobalt, CoAsS.

Isometric. Commonly in cubes and pyritohedrons; also massive. Cleavage perfect cubic. Color reddish white. Streak grayish black. Metallic luster. H=5.5; G=6—6.3.

Cobalt and nickel compounds are very rare in the State, and only an occasional specimen is found.

Mariposa County: Good crystals were found in the Copper Chieftain mine.

Mono County: Occurred with gold in the Tioga mine, Turner[2].

Nevada County: Small seams of cobaltite with chalcopyrite occur in a schist on Rattlesnake Creek, south of Signal Peak.

Placer County: Found with arsenopyrite in the Metallic mine, near Cisco, and with chalcopyrite about four miles northeast of Alta.

46. ARSENOPYRITE—Mispickel—Arsenical Pyrites.

Sulpharsenide of iron, FeAsS.

Orthorhombic. Common in crystals. Generally compact to granular massive. Color silver white to steel gray. Streak grayish black. Metallic luster. H=5.5—6; G=5.9—6.2.

Arsenopyrite is a very common vein mineral and is sometimes highly auriferous. The concentrates from most of the mining regions of the State generally contain more or less of it and in some districts arsenopyrite is the chief gold-bearing ore. Most of the arsenic of commerce is

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obtained from this mineral generally as a by-product in the smelting for gold and silver.

Danaite is a variety containing from four to ten per cent of cobalt.

Amador County: In the New Hope mine, in Quartz Mountain mines, and in the mines between Jackson and Mokelumne Hill, arsenopyrite occurs.

Calaveras County: Near Angels and in the mines along the Mother Lode considerable arsenopyrite has been found high in gold content.

El Dorado County: Occurred in the Florence mine near Placerville, and also near Georgetown.

Imperial County: Found in the mines of the Cargo Muchacho district.

Kern County: The Sumner, Confidence, Relief and other old mines near Kernville and Havilah contained auriferous arsenopyrite.

Mariposa County: In mines near Coulterville; danaite with erythrite was found in the Josephine mine, Bear Valley, Turner[4].

Mono County: Common in the Lundy district carrying gold.

Nevada County: Found in the Betsy mine, Grass Valley and in the Meadow Lake district. Danaite was found in the Meadow Lake district, W. P. Blake[10].

Placer County: One of the minerals in the mines of the Ophir district, Lindgren[6].

Plumas County: Large bunches in Pilot Hill gold mine, six miles northwest of Gibsonville.

San Diego County: Occurs in the Julian district.

Sierra County: The chief gold-bearing mineral at Alleghany and containing a high percentage of gold. In the Golden King mine on Kanaka Creek it is said to have occurred with gold telluride.

Tulare County: Found in the Mineral King district.

47. SMALTITE—Cobalt Glance.

Arsenide of cobalt, $CoAs_2$.

Isometric. Generally massive. Color tin white. Streak grayish black. Metallic luster. H=5.5—6; G=6.4—6.6.

Smaltite usually contains some nickel and it is the more common form of cobalt compound. A few small veins and seams of the mineral have been found in the State but no important deposits.

Lassen County: Specimens of gray smaltite with erythrite and annabergite as alteration products have come from some locality in this county.

Los Angeles County: At the old Kelsey and O. K. mines in San Gabriel Canyon smaltite coated with erythrite occurred with the native silver and argentite.

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Napa County: The mineral has been found in thin seams with erythrite in the serpentine rock of the Beryessa Valley.

Nevada County: Occurs in the Meadow Lake district.

48. LÖLLINGITE.

Arsenide of iron, $FeAs_2$.

Orthorhombic. Small crystals or granular. Color silver white to light steel-gray. Streak grayish black. Metallic luster. H=5—5.5; G=7—7.2.

This mineral is rare as most of the arsenical iron is arsenopyrite.

Leucopyrite is a variety with a different proportion of arsenic and iron, Fe_3As_4.

Amador County: Small crystals of löllingite were found in the black slate at the Mayflower mine, Amador City.

Los Angeles County: Specimens of leucopyrite have come from this county, Hanks[6].

49. TIEMANNITE.

Selenide of mercury, HgSe.

Isometric, tetrahedral. Generally massive. Color dark lead-gray. Streak black. H=2.5; G=8.30—8.47.

The selenide is not a common form of mercury but some large masses of it have been found in the cinnabar districts.

Lake County: According to W. P. Blake[9] the mineral occurred in large masses in the vicinity of Clear Lake. Masses of it occurred in the Abbott mine associated with cinnabar and petroleum.

Orange County: Found with cinnabar and metacinnabarite at the San Joaquin Ranch mine.

Santa Clara County: Found with cinnabar at the old Guadalupe mine near New Almaden.

50. TETRADYMITE.

Telluride of bismuth, Bi_2Te_3.

Hexagonal, rhombohedral. Commonly granular. Color steel-gray. H=1.5—2; G=7.2—7.6. Cleavage perfect basal. Metallic luster.

This rare telluride is probably present in some of the gold mines where bismuth and tellurium are found in the concentrates, but it has only been identified in a few localities.

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Calaveras County: Found with gold in the Melones and in the Morgan mines on Carson Hill, associated with other tellurides of this famous telluride locality, Hanks[6].

Nevada County: Occurred at the old Murchie mine near Nevada City, Hanks[6].

Tuolumne County: Small amounts have been found at the Soulsby mine.

51. HESSITE.

Telluride of silver, Ag_2Te.

Isometric. Generally in distorted octahedrons. Sometimes massive. Color lead-gray to steel-gray. Streak dark gray to black. Metallic luster. H=2.5—3; G=8.31—8.45.

Hessite generally contains gold and often grades into petzite so the two tellurides are apt to be together in mines. They are the more common forms of tellurium and occur in most mines where gold tellurides are found, often associated with sylvanite or calaverite.

Calaveras County: Hessite was one of the tellurides of the old Stanislaus mine on Carson Hill. It was analysed by Genth[4].

Au	Ag	Pb	Ni	Te	
3.28	46.34	1.65	4.71	44.45	=100.43.
3.22	55.60	--	1.54	(39.64)	

El Dorado County: Found massive as a drift specimen with galena and inclosing gold at Georgetown, W. P. Blake[5].

Kern County: Has been observed with the silver minerals at the Amalie mine.

Nevada County: A specimen of pyrite, galena and native gold from the Nevada City mine contained some soft gray hessite, Lindgren[6].

Shasta County: Found in the Shearer and Rattler mine, 3 miles from Redding.

Sierra County: Found in the Golden King mine on Kanaka Creek near Alleghany.

Tuolumne County: Occurred in the old Reist mine on Whiskey Hill, Silliman[6]. Is present in the Jumper and Bonanza mines near Jamestown.

52. PETZITE.

Telluride of silver and gold $(Ag,Au)_2Te$.

Massive. Color steel-gray to black. Streak black. Metallic luster. H=2.5—3; G=8.7—9.0.

Petzite is usually associated with hessite, sylvanite and calaverite. It is the commonest form of the gold telluride found in the State.

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Calaveras County: Found with hessite in the Stanislaus and Melones mines on Carson Hill. Specimens from the Stanislaus mine have been analysed by Genth[4] and Kustel[1].

	Au	Ag	Te	
Genth	25.55	41.93	32.52	per cent
	25.70	42.36	31.94	
Kustel	24.80	40.60	35.40	

El Dorado County: Found with calaverite at the Darling mine about three miles northeast of American Flat.

Inyo County: Occurs at Telluride in the Gilt Edge claim seven miles southeast of Olanche.

Tuolumne County: One of the tellurides in the Golden Rule, Rawhide Ranch and Norwegian mines near Tuttletown. Analysed from the Golden Rule mine by Genth[4] and from the Norwegian mine by Hillebrand[1].

	Au	Ag	Te	Se	MnO	
Golden Rule	25.60	41.86	32.68	--	--	=100.14 per cent
	24.97	40.87	34.16	--	--	=100.00
Norwegian	25.16	41.87	33.21	tr.	0.08	= 99.32

53. ALTAITE.

Telluride of lead, PbTe.

Isometric. Small octahedrons and massive. Color tin-white to dark gray. Metallic luster. H=3; G=8.16.

Altaite is found associated with hessite, petzite and gold tellurides in a few localities.

Calaveras County: Occurred with hessite and petzite at the Stanislaus mine, Carson Hill, and analysed by Genth[4].

Pb	Ag	Au	Te	
60.71	1.17	0.26	37.31	= 99.45 per cent

Nevada County: One of the minerals at the Providence mine, Nevada City, occurring in bunches in the Ural vein intergrown with native gold and associated with quartz, pyrite and galena, Lindgren[6].

Tuolumne County: Occurred in the Golden Rule mine, near Tuttletown, Genth[4].

Also at Sawmill Flat with the forms (111) and (322) and was partly analysed by Sharwood, Eakle[1].

Pb	Ag	Au	Te
65.0	tr.	none	35.0

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54. COLORADOITE.

Telluride of mercury, HgTe.

Massive, granular. Color iron-black. Metallic luster. H=3; G=8.63.

The telluride of mercury is a very rare mineral, and only one specimen has been found in the State.

Tuolumne County: Hillebrand[1] found one specimen which he identified as coloradoite, associated with the other tellurides of the Norwegian mine near Tuttletown.

55. MELONITE.

Telluride of nickel, Ni_2Te_3.

Hexagonal. Commonly granular and foliated. Cleavage perfect basal. Color reddish white. Streak dark gray. Metallic luster.

This rare telluride has only been found in one locality, and there is some question of its exact formula.

Calaveras County: The rare telluride of nickel was discovered among the other tellurides of the Melones mine on Carson Hill in 1867 and was named by Genth[3][4], for the mine. A similar mineral was later found in the Stanislaus mine and analysed by Hillebrand[1].

	Te	NiCo	Pb	Ag	
Genth	73.43	20.98	0.72	4.08	=99.21 per cent
Hillebrand	80.75	18.31	--	0.86	=99.92

56. SYLVANITE—Graphic Tellurium.

Telluride of gold and silver, (Au, Ag)Te_2.

Monoclinic. Bladed crystals and massive. Cleavage perfect clinopinacoidal. Color yellowish silver-white. Streak silver gray. Metallic luster. H=1.5—2; G=7.9—8.3.

This important telluride may be present in many of the gold districts where tellurium is found, as it is one of the commoner forms of tellurium. It has been identified in very few localities.

Calaveras County: Sylvanite was one of the tellurides occurring in the Carson Hill mines and was especially prominent in the Melones and Stanislaus mines. An analysis of it from the latter mine was made by Stetefeldt[1].

Te	Au	Ag
59.6	25.5	13.9

Trinity County: It has been found with gold in the Yellow Jacket mine, and with nagyagite at the Dorleska mine, Coffee Creek district.

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57. CALAVERITE.

Telluride of gold and silver, $(Au, Ag)Te_2$.

Monoclinic. Crystals with striated faces; also massive. Color pale bronze-yellow to yellowish silver-gray. Streak yellowish gray. Metallic luster. H=2.5; G=9.04.

A chemical investigation of the various telluride minerals from the mines on Carson Hill by Genth[4], proved the existence of a new telluride of gold and silver which he named after the county. Since that original discovery, the mineral has been found in very valuable deposits at Cripple Creek, Colorado, and in Australia.

Calaveras County: Discovered at the old Stanislaus mine and later in the Melones mine, the latter mine being the only one of this famous group of mines on Carson Hill still in active operation. An analysis of the mineral from the Stanislaus mine was made by Genth[4].

Au	Ag	Te	
40.70	3.52	55.89	=100.11 per cent
40.92	3.08	(56.00)	

El Dorado County: Found with petzite in the Darling mine near Rock Creek, about three miles northeast of American Flat.

58. NAGYAGITE.

Sulpho-telluride of gold, lead and antimony, $Au_2Pb_{14}Sb_3Te_7S_{17}$.

Orthorhombic. Generally foliated and granular. Perfect cleavage into thin flexible laminae. Dark lead-gray color and streak. Metallic luster. H=1—1.5; G=6.85—7.2.

This is a very rare telluride and has only been observed at one locality in California.

Trinity County: Observed with hessite at the Dorleska mine, Coffee Creek district.

SULPHO-SALTS- SULPHANTIMONITES AND SULPHARSENITES.

59. BERTHIERITE.

Sulphantimonite of iron, $FeSb_2S_4$.

Long prismatic. Usually fibrous massive. Color dark steel-gray. Streak grayish black. Metallic luster. H=2—3; G=4—4.3.

This is a rare iron compound and its existence in the State has not been definitely established.

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Tuolumne County: Heavy ledges of dark ore occur in an area of schists on the southeast slope of Mount Gibbs, which appear to be an impure berthierite mixed with galena, pyrite and quartz, Turner[4].

60. JAMESONITE—Feather Ore.

Sulphantimonite of lead, $Pb_2Sb_2S_5$.

Orthorhombic. Generally fibrous massive. Cleavage perfect basal. Color lead-gray. Streak grayish black. Metallic luster. H=2—3; G=5.5—6.0.

Jamesonite is one of the common lead sulpho-salts and is often present in silver-lead districts, sometimes in large masses.

Calaveras County: Found at Mokelumne Hill, Hanks[6].

Inyo County: Compact massive specimens have come from the Cerro Gordo mine, associated with argentiferous galena.

Napa County: The delicate capillary or hair-like variety was found with cinnabar at the Manhattan mine, near Knoxville.

61. BOURNONITE.

Sulphantimonite of lead and copper $(Pb,Cu_2)_3Sb_2S_6$.

Orthorhombic. Short prismatic and tabular crystals and massive. Color and streak lead-gray. Metallic luster. H=2.5—3; G=5.7—5.9.

Bournonite is occasionally found in silver-lead districts where copper is also a constituent of the veins. It occurs in good crystals as well as massive.

Inyo County: The only known occurrence of the mineral is at Cerro Gordo, where it is found massive, Reid[4].

62. PYRARGYRITE—Dark Ruby Silver.

Sulphantimonite of silver, Ag_3SbS_3.

Hexagonal, rhombohedral. Prismatic crystals. Also massive. Color grayish black, or dark red. Streak purplish red. Metallic luster. H=2.5; G=5.85.

The ruby silver ore is found in silver veins as a secondary mineral and is associated with argentite, polybasite, stephanite, tetrahedrite and other silver minerals. It is characteristically found as dark gray blotches and bands with red streaks, in massive white quartz.

Alpine County: It occurred in the old I X L and Exchequer mines of the Silver Mountain district.

Kern County: Found associated with argentite at the Amalie mine.

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Mono County: In the Oro, Addenda, Fortuna and other mines south of Bodie pyrargyrite and stephanite were abundant. Crystals were found in a vugg in the Bodie mine. Pyrargyrite also occurred in the Blind Spring mines, in the Tower mine, and in other mines near Benton, Whiting[1].

Nevada County: Found in a specimen from the Allison Ranch mine, associated with pyrite, chalcopyrite and galena; also in the Central mine south of Banner Hill, and is probably present in other mines of the Grass Valley and Nevada City district as indicated by the silver-rich concentrates, Lindgren[6].

Shasta County: Small amounts of pyrargyrite were occasionally found in the mines near Igo.

63. TETRAHEDRITE—Gray Copper.

Sulphantimonite of copper, $Cu_8Sb_2S_7$.

Isometric, tetrahedral. Generally massive. Color dark steel-gray. Streak black, sometimes cherry-red. Metallic luster. H=3—4.5; G=4.4—5.1.

The steel-gray metallic tetrahedrite is quite common in many of the gold and copper mines of the State. It is, however, seldom prominent but occurs in small amounts mixed with galena, sphalerite, chalcopyrite and other common sulphides.

Freibergite is the argentiferous variety and is perhaps the most common form of the mineral in California.

Tennantite is a sulpharsenite of copper and while really a distinct mineral, it may be considered as a form of tetrahedrite with its antimony replaced by arsenic. The two minerals are seldom differentiated.

Alpine County: Considerable tetrahedrite has been found in the Silver Mountain district.

Calaveras County: Small amounts of the mineral were found in the mines on Carson Hill.

Del Norte County: Found at Crookeshine.

Imperial County: Occurred in the Blue Jacket and other mines of the Picacho district.

Inyo County: Tetrahedrite was an important mineral in the Cerro Gordo district containing a large percentage of silver. Occurred also in some of the White Mountain mines, in the mines of the Dutton Range and in the old San Carlos mine.

Los Angeles County: Found in the Zapate mine in the San Gabriel Canyon.

Mariposa County: A common mineral in the gold mines of the county, associated with quartz, pyrite, galenite and sphalerite. The silver-rich variety freibergite was found in large masses in white quartz,

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at the Live Oak mine, near Mariposa, Hanks[6]. The mineral also occurred in the Pine Tree mine near Coulterville.

Mendocino County: In the Redwood Copper Queen mine with chalcopyrite, gold and silver.

Mono County: An important silver ore in several districts. In the Diana, Comet, Comanche and other mines of the Blind Spring Hill district, it occurred massive associated with partzite. Also found in the Bodie district.

Nevada County: A heavy mass was found in the Osborn Hill vein, associated with zincblende and chalcopyrite. In small quantities at the North Banner and at other mines of the Banner Hill and Willow Valley districts, Lindgren[6].

Placer County: Dark steel-gray tetrahedrite associated with other sulphide minerals and with electrum was quite common in the Ophir district, having been noticed in the Boulder, Gold Blossom, Pine Tree and Golden Stag mines, Lindgren[4].

Plumas County: Found at the Irby Holt mine in Indian Valley.

San Bernardino County: It has been found massive in the New York and other mines in the New York Mountains.

Shasta County: Gray copper is of rather common occurrence in the copper mines of the county although in small amounts. It has been found in a barite gangue in the Bully Hill mine.

Tuolumne County: Occurred as one of the minerals on Whiskey Hill, Silliman[5]. Found massive in the Golden Rule mine, near Jamestown.

64. GEOCRONITE.

Sulphantimonite of lead, $Pb_5Sb_2S_8$.

Orthorhombic. Generally massive, granular or earthy. Color bluish lead-gray. Streak lead-gray. Metallic luster. H=2.5; G=6.3 — 6.45.

Geocronite is one of the very rare lead minerals found in the State.

Inyo County: According to Hanks[6], small masses were found with galena in the Inyo Mountains.

Mono County: It was observed in the Garibaldi mine, Prescott district, associated with galena and sphalerite.

65. STEPHANITE—Brittle Silver—Black Silver.

Sulphantimonite of silver, Ag_5SbS_4.

Orthorhombic. Crystals common, usually with striated faces. Also massive. Color iron-black. Streak black. Metallic luster. H=2 — 2.5; G=6.2 — 6.3.

Stephanite is a very important and usually prominent silver mineral in silver districts but it does not appear common in California. It is

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often associated with argentite and polybasite as an original mineral of the veins.

Alpine County: Said to have been found in the Morning Star mine, J. D. Dana[1].

Mono County: In the Blind Spring Hill district it occurred as one of the associate minerals. Large masses were found with pyrargyrite in the Oro, Addenda and Fortuna mines, Bodie district, Whiting[1]. Also one of the minerals of the Sweetwater Range north of Bridgeport.

Nevada County: One of the minerals found in the Grass Valley mines, Lindgren[6].

66. POLYBASITE.

Sulphantimonite of silver, Ag_9SbS_6.

Orthorhombic. Tabular crystals and massive. Color iron-black. Streak black. Metallic luster. H=2—3; G=6.2.

Polybasite closely resembles stephantite; the two are often mixed and are seldom differentiated. When in good crystals they can be told apart but when massive their separate identification is difficult.

Alpine County: The only reported occurrence of polybasite is from this county. Specimens have come from the Pennsylvania mine in the Silver Mountain district, and Hanks[6] observed it in microscopical crystals from the Monitor and Mogul districts.

67. DUFRENOYSITE.

Sulpharsenite of lead, $Pb_2As_2S_5$.

Orthorhombic. Generally massive. Color dark lead-gray. Streak reddish brown. Metallic luster. H=3; G=5.56.

This compound of lead is a very rare mineral and its existence in California is somewhat doubtful.

Inyo County: Reported to have been found in the Cerro Gordo district, Hanks[6].

68. PROUSTITE—Light Ruby Silver.

Sulpharsenite of silver, Ag_3AsS_3.

Hexagonal, rhombohedral. Prismatic crystals and massive. Color and streak scarlet-red. Adamantine luster. H=2—2.5; G=5.5.

The term "ruby silver" is given indiscriminately to proustite and pyrargyrite. Both minerals usually contain arsenic and antimony and they often grade into each other. The metallic gray pyrargrite is more

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common than the transparent red proustite, but the two are often associated.

Kern County: Specimens of proustite with pyrargyrite have been found in the Amalie mine.

Mono County: Found in the Oro and Bodie mines, Bodie district, Hanks[6].

Shasta County: Occurred in the Chicago mine near Igo, associated with galena, pyrite and quartz.

69. ENARGITE.

Sulpharsenite of copper, Cu_3AsS_4.

Orthorhombic. Crystals and massive. Cleavage perfect prismatic. Color grayish black. Streak black. Metallic luster. H=3; G=4.4.

Enargite is a valuable but not a common copper compound in the State. Very few of the copper districts show it even in small amounts.

Famatinite is a corresponding sulphantimonite of copper and the enargite of Alpine County appears to grade into this mineral.

Alpine County: Enargite was found in large masses associated with massive pyrite in the Mogul district and formed the chief copper mineral of the Morning Star and a few other mines of this locality. An analysis of the mineral was made by Root[1] from the Morning Star mine.

S	Cu	As	Sb	
31.68	47.21	14.06	6.19	=99.14 per cent

Crystals have the forms: (110), (001), (100), (010), Silliman[8] and (130), (250), (101), Eakle[7].

El Dorado County: Some enargite was found in the Ford mines near Georgetown.

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CHAPTER IV.

HALOIDS: CHLORIDES, BROMIDES, IODIDES AND FLUORIDES.

Chlorides.
Calomel
Halite
Sylvite
Sal Ammoniac
Cerargerite
Chlormagnesite
Atacamite
Eglestonite

Bromide.
Embolite
Iodide.
Coccinite
Fluoride.
Fluorite

70. CALOMEL.

Chloride of mercury, Hg_2Cl_2.

Tetragonal. Small crystals. Color white, gray, brown. Adamantine luster. H=1—2; G=6.48.

The calomel used in medicine is a manufactured product as the natural mineral is very rare. It is sometimes found in clear colorless crystals of a brilliant adamantine luster, and in white crystalline coatings, in cinnabar districts.

Napa County: White coatings of the mineral on metacinnabarite occurred at the Oat Hill mine.

San Mateo County: Small amounts of calomel associated with cinnabar, native mercury and eglestonite occur about five miles west of Palo Alto, Rogers[4]

71. HALITE—Rock Salt.

Chloride of sodium, NaCl.

Isometric. Cubes massive, granular and crusts. Cleavage perfect cubic. Color white, reddish and colorless. Vitreous luster. H=2.5; G=2.13.

Most of the salt produced in the State is obtained by the evaporation of the water of San Francisco Bay, yet extensive deposits of the mineral exist in the southern counties and some of them are mined. Salt is of very common occurrence in the desert regions, where former lakes existed, and the deposits reach considerable thickness in some localities, often alternating with beds of sulphates, borates, carbonates and mud shales. Salt wells, salt springs, salt marshes, and salt rivers occur in these arid plains and white incrustations of salt are often found along their borders.

Alameda County: The salt works at Alvarado evaporate the water of San Francisco Bay on a large scale, and the bulk of the salt produced in the State is obtained by this method.

Imperial County: Efflorescences of salt on the dry plains of the Great Colorado Desert were early reported.

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Inyo County: Salt is common in the dry valleys as white efflorescences and in solution in many of the springs, marshes and lakes of this county. In the borax district of Death Valley it is a common associate, and the bottom of this valley is an extensive salt marsh, into which the Amargosa River sinks. The waters of Owens Lake have been evaporated for salt and soda.

Kern County: In the Mojave Desert region on the eastern side of the county, numerous salt lakes and wells occur. The alkaline desert from the Kern River to the Cañada de las Uvas is impregnated with salt. Salt and borax are associated at the Buckthorn, Indian and Mesquite springs.

Riverside County: The well-known Salton Sea is an extensive depression in the south central part of the county which was noted for its immense deposits of white salt and where thousands of tons have been gathered. It is now covered by the waters of the Colorado River and the salt works have been wholly obliterated. An analysis of this salt was made by Allen[1].

NaCl	CLl	No_2So_4	Gypsum	H_2O	Insol.	
94.54	0.31	3.53	0.79	0.14	0.50	=99.81 per cent

San Bernardino County: Numerous dry lakes exist in this county, all of which contain salt. Some of the salt near Daggett has been mined locally for chloridizing the silver ores of the district. A large lake deposit occurs in the desert about twenty-five miles southeast of Danby and the Surprise salt mines have produced large quantities. Bailey[1] reports a vein of rock salt 12 to 16 feet thick on the Avawatz Mountains. Crusts of the mineral associated with sodium, magnesium and calcium sulphate occur at the Mojave sink. Salt and borax with some nitrates exist along the Amargosa River, near the Inyo County line.

San Luis Obispo County: Along the shores of the Salinas River white crusts of salt can be found in many places. The Soda Lake in Carissa Plains is a dry lake in the eastern part of the county, and the surface contains crusts of salt and sodium sulphate.

Shasta County: Sandstones occur on Salt Creek, about twelve miles east of Redding, which are slightly impregnated with salt.

72. SYLVITE.

Chloride of potassium, KCl.

Isometric. Cubes and octahedrons; also granular massive. Cleavage perfect cubic. Colorless to white. Vitreous luster. H=2; G=1.97 — 1.99.

The potassium salt is sometimes associated with the sodium salt, but, unlike the sodium chloride, it is very rare and no deposits of it occur in the State.

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Inyo County: According to Bailey[1] sylvite occurs in traces in some of the springs of this county. Analyses of some of the impure salt covering depressions in Death Valley show low percentages of potassium chloride.

73. SAL AMMONIAC—Salmiac.

Chloride of ammonium, NH_4Cl.

Isometric. Crystals, crusts and efflorescences. Color white, yellowish. Vitreous luster. H=1.5—2; G=1.53.

Inyo County: According to Bailey[1] sal ammoniac is found as efflorescences at some of the fissure springs in Death Valley.

Los Angeles County: A white crystalline incrustation of sal ammoniac was found in the Monterey shale of Burning Mountain, Rogers[5].

Santa Barbara County: Crusts 5 mm. thick, associated with sulphur, came from burning oil-shales on the Hope Ranch, Rogers[5].

74. CERARGYRITE—Hornsilver.

Chloride of silver, AgCl.

Isometric. Usually in thin plates and crusts. Sometimes massive. Color gray but generally tarnished brown. Highly sectile. Waxy. H=1—1.5; G=5.55.

Cerargyrite has been one of the most important silver minerals of the State. It is characteristic of silver deposits located in arid regions and is often abundant in such regions. It has been formed in general by solutions from above carrying alkali chlorides, obtained from the overlying strata, acting on the silver minerals of the veins and forming solutions of silver chloride, from which the mineral is precipitated along fissures and in cavities of the gangue, mostly in the oxidized zones of the deposit. It is usually accompanied by the chlorobromide, embolite, and occasionally by the iodide, iodyrite. Barite is a common gangue mineral.

Inyo County: Hornsilver with argentiferous galena, argentite and copper minerals has been found abundant in the Argus and Coso ranges and to some extent in the Darwin and Cerro Gordo districts. Hanks[6] mentions it from the Slate Range and in microscopical crystals at the Modoc mine near Darwin.

Kern County: The mineral has been found in the Amalie mine with pyrargyrite and native silver.

Mono County: Cerargyrite has been found in the Blind Springs district near Benton and in some of the mines of the Bodie district, but never in large masses. It occurs also in the Sweetwater Range.

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Placer County: It occurred in small amounts as one of the minerals in the Ophir district, on Duncan Hill, Lindgren[4].

San Bernardino County: Hornsilver has been a very important silver mineral in the Calico and Barstow mines. The chloride, together with the chlorobromide, has been deposited along the fault planes and in the numerous fissures of brecciated vein-rock formed by much faulting. The minerals associated with the hornsilver of this region are embolite, cerrusite, barite, pyrolusite, chrysocolla, malachite and jasper. It occurs with limestone associated with embolite, wulfenite, sphalerite, galena, cerrusite and pyrite in the Silver Reef district, on the desert about forty miles east of Victor. It is associated with argentite and secondary from it at the Bonanza King mine on Providence Mountain and in the Imperial mine, Lava Beds district, about nine miles from Lavic. Cerargyrite was reported as one of the minerals with borax at Searles Lake, but the locality was probably Calico. The silver deposits at Calico and Barstow have been fully described by Lindgren[1] and by Storms[1].

75. CHLOROMAGNESITE.

Chloride of magnesium, $MgCl_2$.

Efflorescence. Color white.

Magnesium chloride exists in soluble state in the waters of some of the springs and lakes but its easy solubility prevents it from forming as a mineral except in the dryest climate.

San Bernardino County: White efflorescences of chloromagnesite occur at Saratoga Springs, near the southern end of Death Valley, Bailey[1].

76. ATACAMITE.

Hydrous oxichloride of copper, $Cu_2ClH_3O_3$.

Orthorhombic. Slender needles and fibrous reticulated masses. Color deep grass-green. H=3 — 3.5; G=3.7.

Atacamite is a very rare form of copper and its occurrence in California has not been definitely established.

Inyo County: J. D. Dana[3] gives this mineral from an unknown locality in this county. As the Cerro Gordo mine was the best known for rare minerals, the atacamite, if correctly identified, perhaps came from this mine.

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77. EGLESTONITE.

Oxichloride of mercury, Hg_4Cl_2O.

Isometric. Minute crystals. Color yellowish brown, changing to black. Resinous to adamantine luster. H=2—3; G=8.327.

This is a very rare mercury mineral which has been found associated with cinnabar, metallic mercury and calomel.

San Mateo County: Minute yellow crystals of eglestonite occur about five miles west of Palo Alto in seams and cavities in the silicious material so common in the serpentine of the cinnabar districts, and the crystals were described by Rogers[4]. Forms: cube (100), octahedron (111), rhombicdodecahedron (110), and trapezohedron (211).

Hg	Cl
88.00	7.43

The mineral was associated with cinnabar, mercury, calomel, dolomite, magnesite, opal and quartz.

78. EMBOLITE.

Chlorobromide of silver, Ag (Br, Cl)

Isometric. Generally massive. Color green. Resinous luster. H=1—1.5; G=5.31—5.43.

The greenish embolite has only been found in association with cerargyrite and in much smaller amounts.

Inyo County: Found with cerargyrite in the Indiana mine near Swansea, Hanks[6].

Mono County: In the Minnie mine, Sweetwater Range, with horn-silver, Hanks[6].

San Bernardino County: An associate of the cerargyrite in the Calico, Grapevine and Silver Reef districts. One of the minerals reported with borax at Searles Lake, probably, however, from the Calico district.

79. COCCINITE.

Iodide of mercury, HgI.

Thin coatings. Color reddish brown.

Traces of iodine have been found in some of the springs of the State, but the occurrence of any iodide is questionable.

Kern County: This rare reddish brown iodide is said to have been found with stibnite in the San Emidio Canyon, J. D. Dana[3].

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80. FLUORITE.

Fluoride of calcium, CaF_2.

Isometric. Usually in cubes. Also massive, granular or compact. Cleavage perfect octahedral. Colorless, green, yellow, purple, blue, white. Vitreous luster. H=4; G=3.2.

Fluorite is a common mineral, especially as gangue in lead districts with galena. It sometimes forms thick veins and becomes important as a flux. No good deposits are known in the State.

Contra Costa County: Small cubes of white fluorite were found on Mount Diablo with some copper minerals, Hanks[6].

Inyo County: Found as a gangue mineral with argentiferous galena in the Cerro Gordo, Darwin and other districts.

Los Angeles County: Fine specimens have come from the Felix mine near Azusa, consisting of purple and green masses and cubes. White fluorite occurred on Santa Catalina Island with galena and chalcopyrite.

Mono County: In the Ferris Canyon on the east slope of the Sweetwater Mountains green and violet crystals and masses occur.

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CHAPTER V.

OXIDES OF HYDROGEN, SILICON AND SEMI-METALS.

Hydrogen.
Water
Silicon.
Quartz
Chalcedony
Tridymite
Opal

Semi-metals.
Arsenolite
Valentinite
Bismite
Molybdite
Cervantite
Stibiconite
Stibioferrite
Partzite
Stetefeldtite

81. WATER.

Oxide of hydrogen, H_2O.

Hexagonal when solid, as ice. Colorless. Brittle. H=1.5; G=0.916.

The mineral springs of California are very numerous and of a great variety. Many of them have a reputed medicinal value and have become popular health resorts.

Thermal springs are common and many of them represent the lingering remnant of a former volcanic activity of the region. Some owe their origin to the heat developed by decomposition of sulphides and other mineral bodies below, in the courses of the underground waters. These springs are usually strongly sulphurous as well as hot.

The salts most commonly found in the spring waters of the State are the carbonates, sulphates and chlorides of magnesium, sodium, calcium and iron. Traces of boron are found in many and in some localities like Clear Lake, Lake County, and the desert regions of Inyo and San Bernardino counties, boracic acid has been an abundant ingredient.

Some of the lakes are also strongly saturated with salts, and Mono Lake and Owens Lake are noted for the large percentage of solid contents of their waters, mostly sodium bicarbonate.

Stream waters are purest in granitic regions, less pure and harder in limestone regions, and quite impure and strongly alkaline in the arid regions.

82. QUARTZ—Silica.

Oxide of silicon, SiO_2.

Hexagonal, rhombohedral. Hexagonal prisms with pyramids very common and sometimes large. Compact and granular massive. Prominent conchoidal fracture. Colorless, white, yellow, red-brown, etc. Optically positive. Vitreous luster. H=7; G=2.65.

Silica constitutes about three fifths of the solid crust of the earth; consequently quartz and chalcedony and their varieties are exceedingly

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common minerals. It is usual to class under quartz those forms of silica which are phenocrystalline, that is, those with a distinct crystalline structure, and under chalcedony those forms which are cryptocrystalline, that is, those so finely crystalline that they appear noncrystalline except under the microscope. Under each of these two mineral species are grouped many varieties based generally on color and structure.

Common quartz is an essential constituent of granites, granodiorites, quartz-porphyries, rhyolites, gneisses, schists, quartzites and sandstones and is an accessory mineral in many other kinds of rock, either volcanic, metamorphic or sedimentary. Veins, ledges, seams and pockety masses of white quartz are common in volcanic and metamorphic areas and much of it in California is gold-bearing. In ordinary rock decomposition silica remains as a residual product, as it is practically unattacked by the usual weathering agencies.

Rock crystal is the clear colorless variety which is seldom to be found except as hexagonal crystals. Fine large groups of these crystals are frequently found in the mines.

Amethyst is the variety colored violet by manganese or possibly titanium. It also occurs in groups of crystals, being rarely massive. Very little good amethyst has been found in the State.

Rose quartz is a massive variety colored pink by manganese. Some very deep colored rose quartz has been found.

Smoky quartz or *Cainngorm stone* is the hair-brown transparent variety, also in crystals, the color being due to carbonaceous material. The color is readily discharged or converted into citrine-yellow by heat and much of the so-called "false topaz" has been made in this way. This is a very common variety and some excellent large crystals have been found in the State.

Inclusions of other minerals in quartz are very common and have several varietal names.

Phantom crystals show the outlines of one crystal within another, due to inclusions of green chloritic matter or brownish earthy material arranged about the boundaries of the forming crystal during a stage in its growth. Some fine phantom crystals have come from near Placerville.

Sagenite or rutilated quartz is rock crystal pierced by long red needles of rutile. No good sagenite has been found in the State.

Thetis hairstone is rock crystal containing long hair-like fibers of asbestos or actinolite.

Aventurine is glassy quartz speckled with flakes of hematite or brown mica. Good aventurine is very uncommon.

Alpine County: Fine specimens of rose quartz have been found in Hope Valley and in the Mogul and Monitor districts.

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Amador county: Fine large specimens of rock crystal have come from Volcano and Oleta. This section has also produced good specimens of amethyst, smoky and rose quartz. Thetis hairstone has been found at Oleta.

Butte County: Smoky quartz occurs on the North Fork of Feather River.

Calaveras County: Good rock crystal in fine large aggregates have been found in many of the gold mines. Mokelumne Hill, Green Mountain gravel mine near Murphy, Angels and West Point have produced large crystals.

El Dorado County: Rock crystal, phantom crystals and smoky quartz have come from near Placerville, which are the best in the State.

Inyo County: Good rock crystal has been found in the Cerro Gerdo and Darwin districts.

Los Angeles County: Thetis hairstone has been found near Los Angeles.

Mariposa County: Fine rock crystal occurs at Mount Bullion.

Mono County: Rock crystal, amethyst and tabular drusy quartz have come from the Bodie district.

Napa County: Good rock crystal occurs near Calistoga.

Nevada County: Good specimens of rock crystal are often found at Grass Valley and Nevada City.

Placer County: Quartz containing green chlorite is found at Shady Run. Rock crystal occurs in the Ophir district.

Plumas County: Rock crystal from the Granite Basin. Some deep colored rose quartz has come from Meadow Valley.

Riverside County: Rock crystal, smoky quartz and pink quartz in fine large crystal are associated with the gem tourmaline at Coahuila.

Sacramento County: Rock crystal is found at Folsom.

San Bernardino County: Quartz with rutile needles has been found in the San Bernardino Range.

San Diego County: Excellent specimens of rock crystals, smoky quartz and pink quartz are associated with the green and pink tourmaline of the county. Large groups of crystals and single crystals of them of a deep rose color occur in the pegmatite veins which carry the tourmaline, some at Pala, Mesa Grande and Rincon. Rock crystal with long and almost black needles of tourmaline occur at Pala. Crystals from Pala and Rincon have the forms: $(30\bar{3}1)$, $(40\bar{4}1)$, $(50\bar{5}1)$, $(11\bar{2}1)$, $(31\bar{4}1)$, $(41\bar{5}1)$, $(51\bar{6}1)$, Waring[1].

Sierra County: Yellow or citrine quartz has been found on Bald Mountain.

Tulare County: Rock crystal occurs at Three Rivers and in Drum Valley.

Rose quartz is found at Bull Run Meadows and at Yokohl.

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83. CHALCEDONY.

Silicon dioxide, SiO_2.

The chalcedonic forms of silica are never transparent, but occur in dense cryptocrystalline masses and layers, translucent to opaque, and without crystal form. Hot solutions, especially alkaline solutions, acting on silicious rocks dissolve some of the silica and this is deposited in layers along the walls of cavities, or completely fills cavities, forming geodes and irregular shaped masses, with often a banded structure. Many of the large masses of chalcedony and jasper have been formed by deposition from springs, whose waters contain soluble silica. Chalcedony is a very common secondary filling of cavities and fissures in volcanic rock, and may form large geodes in this way. There are many names given to the varieties of cryptocrystalline silica which may be classed under the head of chalcedony, most of them based on color or structure. They include *chalcedony, agate, carnelian, sard, prase, heliotrope* or *bloodstone, chrysoprase, onyx, sardonyx, jasper* and *flint,* all of which may be found in the State. Ordinary silicified wood and agatized wood are silicious pseudomorphs after wood.

Myrickite is a local name applied to a chalcedony, having blood-red spots and patches, found about fifteen miles east of Indian Springs, San Bernardino County.

Kinradite is a local name given to a spherulitic jasper occurring on the shores of Golden Gate.

Alameda County: Small geodes of chalcedony are common in the Berkeley Hills.

Alpine County: Red jasper is common in the Monitor district.

Amador County: Bluish chalcedony occurs at Volcano.

Calaveras County: Red, green and brown jasper is found near Murphy. Silicified wood at Angels.

Del Norte County: Agate, chalcedony and jasper pebbles are common beach pebbles at Crescent City.

Humboldt County: The beach pebbles at Big Lagoon are agate, chalcedony, jasper, prase, carnelian, etc.

Inyo County: Porcelain jasper has been found in the Coso district.

Kern County: Blue chalcedony occurs at Kane Springs.

Marin County: The beach pebbles at Bolinas have agate and chalcedony. Red jasper outcrops on Reed Ranch. Spherulitic jasper, called "kinradite," occurs on shore west of Sausalito.

Napa County: Red jasper is found on Mount St. Helena. Chalcedony is common at the Manhattan cinnabar mine, Knoxville.

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Nevada County: Brown jasper occurs at Nevada City. The beach pebbles at Lake Tahoe contain chalcedony, agate, jasper, carnelian, prase, etc. Good moss agate is found near Indian Flat.

Placer County: Fine geodal masses of chalcedony have been found at the Spanish mine, Ophir district.

Plumas County: Banded green and red jasper occurs in the slates and schists west of Meadow Valley.

San Bernardino County: Moss agate has come from the San Bernardino Mountains. Bluish chalcedony is associated with opal in the Black Mountains north of Barstow. Bloodstone and chalcedony with blood-red spots, called "myrickite" is found about fifteen miles east of Indian Springs.

San Francisco County: Red, green and brown jasper is common in the serpentine of San Francisco. Spherulitic jasper called "kinradite" is found near Land's End.

San Mateo County: The beach pebbles at Pescadero contain fine specimens of chalcedony, agate, carnelian, jasper, etc.

Santa Barbara County: The beach pebbles of this county contain agate and chalcedony.

Siskiyou County: Jasper is common with the numerous serpentine beds.

Sonoma County: Red jasper is found at Windsor.

Tulare County: Fine moss agate occurs on Deer Creek. Chrysoprase is found in the mountains east of Visalia, on Deer Creek and at Yocohl.

Tuolumne County: Yellow and brown jasper occurs at Shaws Flat.

84. TRIDYMITE.

Oxide of silicon, SiO_2

Hexagonal. Thin plates often overlapping. Colorless to white. H=7; G=2.28 — 2.33.

Tridymite is a form of silica which is found in recent volcanic rocks. It occurs in thin and often overlapping hexagonal plates, crystallizing as a secondary mineral in the cavities and fissures of the rock. The mineral is generally of microscopic size and therefore is rarely seen, except in thin sections of rocks. As a rock mineral it may occur in all of the recent volcanics.

Mono County: Observed in the cavities of lava as small hexagonal plates, near Bridgeport, with the forms: (0001), $(10\bar{1}0)$, $(32\bar{5}0)$, $(54\bar{9}0)$, $(30\bar{3}4)$, $(10\bar{1}2)$, Schaller[6].

Tuolumne County: Found by Rogers[5] in cavities of an andesite near Jamestown. Occurs as very thin, white hexagonal plates.

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85. OPAL.

Hydrous oxide of silicon, $SiO_2.nH_2O$.

Amorphous. Colloidal massive. Prominent conchoidal fracture. Yellow brown, green, red, white, gray and colorless. Waxy luster. H=5.5—6.5 of compact varieties. G=2.1—2.2.

Opal differs from chalcedony in being wholly amorphous, somewhat softer and containing a varying percentage of water. It is silica which has solidified from a colloidal state. It fills cavities and seams in many different kinds of rock and is a very common form of silica.

Precious opal shows a beautiful play of colors and very little of this variety has been found in the State.

Common opal is the white, yellow, brown, bluish or greenish masses with no opalescence, having a prominent choncoidal fracture. The occurrence of this kind is quite universal.

Hyalite is transparent glassy opal occasionally found in the cavities of volcanic rock.

Cacholong is a pearl-like opal.

Chrysopal or *prase opal* is a name applied to a greenish opal found with chrysoprase.

Moss opal is common opal with moss-like inclusions of pyrolusite, chlorite, etc.

Wood opal is very abundant in the State, especially in the foothills of the Sierras, where whole forests have been covered by the great thickness of gravel. Masses of wood opal are sometimes white, but usually light to dark brown in color. The structure of the wood is often so well preserved that the species can be identified.

Geyserite and *silicious sinter* are names applied to hydrous silica formed about the vents of geysers and hot springs.

Diatomeceous earth, infusorial earth and *tripolite* are names applied to deposits of silica formed by fresh or salt water diatoms. The waters of the lakes during Tertiary time swarmed with infusoria which secreted silica and their silica remains have formed thick and extensive deposits of white and very light chalk-like material.

Alpine County: Wood opal occurs at Red Lake Peak.

Amador County: Wood opal at Volcano. Diatomaceous earth in Ione Valley.

Butte County: Wood opal at Dodson mine.

Calaveras County: Common and hyalite opal has been found at Mokelumne Hill. Wood opal at Chile Gulch, Bald Hill, Angels and other mining camps.

Contra Costa County: Hyalite and common opal has been found on Mount Diablo.

Fresno County: Dendritic or moss opal has come from the mountains east of Fresno.

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Kern County: White opal is found on the summit of Tehachapi mountain.

Lake County: Fiorite opal has been found at Sulphur Bank. Hyalite has come from Middletown and Kelseyville. Diatomaceous earth occurs on Lost Spring Ranch.

Lassen County: Wood opal is found in Surprise Valley.

Los Angeles County: Diatomaceous earth at Santa Monica and on Santa Catalina Island.

Plumas County: Wood opal in Gravel Range.

San Bernardino County: Opal occurs in the Black Mountains about 25 miles north of Barstow, some of which is good gem material and is worked. Most of it is common opal with chalcedony. Some clear hyalite occurs with it.

San Diego County: Diatomaceous earth has come from about forty miles north of San Diego.

San Francisco County: Nodular masses of common opal occur in the serpentine of San Francisco.

San Joaquin County: Diatomaceous earth is found on Staple's Ranch.

San Luis Obispo County: Diatomaceous earth occurs near Port Harford, near Arroya Grande and near Edna.

San Mateo County: Diatomaceous earth at San Gregorio.

Santa Barbara County: A large deposit of diatomaceous earth occurs at Lompoc. Also on south slope of Santa Ynez Mountains and near Santa Barbara.

Mono County: Diatomaceous earth has come from near Bodie.

Monterey County: Diatomaceous earth from near Bradley. The Monterey shales grade into pure diatomaceous earth.

Napa County: Wood opal in large trees occurs in the fossil forest near Calistoga.

Nevada County: Wood opal at Chalk Bluff, Nevada City, North Bloomfield, and Shelly Hill. Masses of moss opal are found at Newtown.

Orange county: Diatomaceous earth around Allison Creek south of El Toro.

Placer County: Wood opal at Gold Run and near Roseville. Diatomaceous earth at Dutch Flat.

San Diego County: Thin coatings of glassy hyalite occur on the quartz and albite at Rincon, Rogers[3].

Shasta County: Diatomaceous earth is found in extensive beds along the Pitt River and on Hat Creek.

Sierra County: Wood opal has come from Downieville.

Siskiyou County: Fire opal has been found near Dunsmuir.

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Sonoma County: Wood opal near Santa Rosa; diatomaceous earth about ten miles north of Petaluma; geyserite at the Geysers.

Tehama County: Diatomaceous earth near Lassen Butte. Probably is volcanic tuff.

Tulare County: Wood opal in Kings River Canyon. Diatomaceous earth near Exeter. Chrysopal or prase opal is a nickel green opal found with chrysoprase in hills east of Visalia and Porterville.

Tuolumne County: Wood opal has been found near Columbia.

86. ARSENOLITE—White arsenic.

Oxide of arsenic, As_2O_3.

Isometric, commonly fibrous crusts and earthy. Color white. Silky or vitreous luster. H=1.5; G=3.7. Taste sweet. Astringent.

The white oxide of arsenic is readily obtained by heating any arsenic compound but it is not very common native.

Alpine County: Found as an alteration of enargite at the Exchequer mine.

Small white octahedrons occur in the pyrite and enargite associated with realgar at the Monitor mine.

San Bernardino County: Large masses occurred with gold at the Amargosa mine, W. P. Blake[9].

87. VALENTINITE.

Trioxide of antimony, Sb_2O_3.

Orthorhombic. Generally columnar masses. Perfect brachypinacoidal cleavage. Color snow-white to ash-gray. H=2.5; G=5.56.

Valentinite is an oxidation product of antimony minerals, especially of stibnite.

San Benito County: Lemon-yellow bladed aggregates of valentinite, probably pseudomorphs after stibnite, occur at the Picahotes mine associated with cinnabar, quartz and chalcedony, Rogers[5].

88. BISMITE—Bismuth Ocher.

Oxide of bismuth, Bi_2O_3.

Orthorhombic. Commonly occurs as an earthy coating. Color yellow to gray. G=4.36.

Bismite occurs generally as a yellowish powder or coating on bismuth minerals, especially native bismuth.

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Mono County: Found at Lone Pine.

San Diego County: Bismuth ocher was found as a yellow and gray powder with native bismuth at Pala, Kunz[5]. This powder is, according to Schaller[9], in part bismuth hydroxide, bismuth vanadate and mixtures of these two. An analysis of the yellow ocher from the Stewart mine showed it to be a mixture of the hydroxide and the vanadate.

		Gang		H_2O			
Bi_2O_3	V_2O_5	Sol. in HNO_3	Insol. in HNO_3	107°	210°	Ign.	
64.43	12.11	2.27	17.63	0.32	0.224	3.43	=100.43 per cent

An analysis of the gray ocher from the Stewart mine showed it to be probably bismuth hydroxide with the formula $Bi_2O_3.3H_2O$.

		Gang		H_2O			
Bi_2O_3	V_2O_5	Sol. in HNO_3	Insol. in HNO_3	107°	240°	Ign.	
64.9	0.8	9.5	13.5	0.4	0.3	11.4	=100.8 per cent

An analysis of the yellow ocher from the Pala Chief mine showed it to be the bismuth vanadate, pucherite.

Yellow bismite in small irregular particles and minute tabular crystals with the forms (100) and (011) occur at the Victor mine, Rincon, Rogers[2].

89. MOLYBDITE—Molybdic Ocher.

Oxide of molybdenum, MoO_3.

Capillary crystals in radiating tufts and earthy. Color straw-yellow. H=1—2; G=4.5.

Molybdite occurs as a yellow powder or as small radiating tufts as a secondary alteration product of molybdenite. Most of the localities given for molybdenite will show some of the yellow oxide.

Mono County: Occurs with molybdenite at Cameron and at Silverado Creek, Whiting[1].

Nevada County: Occurred mixed with limonite at the Wisconsin and Illinois claim, Nevada City.

Tuolumne County: Found in some of the rocks on the Stanislaus River.

90. CERVANTITE—Antimony Ocher.

Oxide of antimony, Sb_2O_3.

Orthorhombic. Usually as a crust or powder. Sometimes massive. Color yellow. H=4—5; G=4.08.

Cervantite usually occurs as a yellowish crust or powder as an oxidation product on stibnite.

Inyo County: Found massive yellow at the Lottie mine, Wild Rose district and at the St. Ignacio mine.

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Kern County: Occurred associated with stibnite at the San Emidio mine.

91. STIBICONITE.

Hydrous oxide of antimony, $Sb_2O_4H_2O$.

Massive or as a crust or powder. Color yellowish white. H=4—5.5; G=5.1—5.28.

Occurs as an alteration product of stibnite or native antimony in massive crusts or powder, of a yellowish white color. It is the common oxidation of antimony minerals.

Kern County: Found with native antimony at Little Caliente Springs.

San Benito County: Occurs with stibnite at some of the mines of the northeast part of the county.

Santa Clara County: Found with stibnite at some of the mines of the county.

92. STIBIOFERRITE.

Hydrous oxide of antimony and iron.

Amorphous. Color straw-yellow. Resinous luster. H=4; G=3.6.

This oxide was found as a thick coating on stibnite from Santa Clara County and was described as a new mineral by Goldsmith[4]. The analysis of the substance suggests that it was a mixture of stibiconite and silicious limonite and not a new mineral.

Sb_2O_5	Fe_2O_3	H_2O	SiO_2	Ign.
42.46	31.85	15.26	8.84	1.09

93. PARTZITE.

Hydrous oxide of antimony, copper and other bases.

Massive. Color blackish green to black. H=3—4; G=3.8.

Blackish green to black masses occurring in the oxidation zone in the mines of the Blind Springs district.

Stetefeldtite is similar to partzite with more silver.

Mono County: Found in the Kerrick, Comanche, Diana and Comet mines of the Blind Springs district and described as a new mineral and analysed by Arents[1]. Considered, however, by W. P. Blake[12] to be a mechanical mixture of the hydrous oxide of antimony with other metallic bases.

Sb_2O_3	Cu_2O	Ag_2O	PbO	FeO	H_2O	
47.65	32.11	6.12	2.01	2.33	8.29	=98.51 per cent

A specimen labeled stetefeldtite has come from the Giant mine.

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CHAPTER VI.

OXIDES OF THE METALS.

Anhydrous.		*Hydrous.*
Cuprite	Rutile	Manganite
Melaconite	Anatase	Göthite
Corundum	Brookite	Limonite
Hematite	Chrysoberyl	Bauxite
Ilmenite	Hausmannite	Brucite
Spinel	Minium	Sassolite
Magnetite	Crednerite	Psilomelane
Chromite	Braunite	Asbolite
Cassiterite	Pyrolusite	Wad

94. CUPRITE—Red Copper.

Red oxide of copper, Cu_2O.

Isometric. Small cubes and octahedrons. Generally massive. Color red. Streak brownish red. Adamantine to submetallic luster. H=3.5—4. G=5.99.

Cuprite occurs in most of the copper localities as a secondary mineral in the oxidized portions of the deposits. Massive specimens have come from various counties but no large bodies of the mineral are known. It is an important ore of copper.

Alameda County: Massive specimens have been found near Livermore.

Amador County: At Volcano.

Calaveras County: Masses are occasionally found at Copperopolis and Campo Seco, associated with the chalcopyrite. Mentioned by Silliman[5] from Quail Hill.

Colusa County: Found at the old Candace and Union mines. The capillary variety *chalcotrichite* with massive cuprite was found in the Lion mine.

Del Norte County: Masses with native copper found at the Pearl copper mine. Common in the Rockland district.

Glenn County: At L'Homme.

Kern County: Found on the old San Emidio Ranch.

Mono County: Massive at the Eclipse, Kerrick and Mammoth mines. Also near Lundy with cerargyrite and chrysocolla.

Napa County: Found near Calistoga and St. Helena, some of it the chalcotrichite variety.

Nevada County: At Meadow Lake.

Placer County: Massive near Lincoln.

Plumas County: In Light's Canyon. With native silver at the Pocahontas mine, Indian Valley.

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San Bernardino County: Massive in Holcombe Valley. Common at the Copper World mine, Clarke Mountain.

Shasta County: Massive pieces have been found at the Peck, Afterthought, Copper City and other mines of this county.

Trinity County: Massive at Trinity Center.

Tulare County: In the Mineral King district.

Tuolumne County: At Whiskey Hill, Silliman[5].

95. MELACONITE—Tenorite—Black Copper.

Oxide of copper, CuO.

Monoclinic. Generally as an earthy powder. Color black. Streak black. Submetallic luster. H=3—4; G=5.82.

The black oxide of copper is a frequent oxidation product of chalcopyrite, forming a black powder or nodular masses. It occurs in many more localities than what can be given here.

Calaveras County: Rather common with the chalcopyrite of Copperopolis and Campo Seco. Large nodular masses have come from the Satellite mine.

Colusa County: Found in serpentine with native copper and cuprite at the Gray Eagle mine.

Del Norte County: With the chalcopyrite at the Alta and Pearl mines.

Nevada County: At the Excelsior mine.

Shasta County: At the Afterthought and other chalcopyrite mines of this county.

96. CORUNDUM.

Oxide of aluminium, Al_2O_3.

Hexagonal, rhombohedral. Prismatic crystals and massive. Cleavage rhombohedral. Color generally bluish gray; also blue, green, yellow and red. Vitreous luster. H=9; G=3.95—4.10.

Corundum-bearing rocks are very rare in the State and no workable deposits of this useful mineral are known. In the few localities where it occurs it exists in very limited quantities. The gem varieties, ruby and sapphire, have not been found in good clear crystals.

Los Angeles County: The first mention of corundum in the State was of some sapphire-blue pebbles found in the drift of the San Francisquito Pass, W. P. Blake[9]. Crystals of ruby corundum occur in a corundum syenite in San Antonio Canyon, near Uplands.

Plumas County: Large crystals of a pale violet-blue shade occur in the plumasite of Spanish Peak, Lawson[3].

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San Bernardino County: Found in the Kingston Range, Kunz[7].

San Diego County: A constituent of the dumortierite schist of De hesa, Schaller[5].

97. HEMATITE.

Sesquioxide of iron, Fe_2O_3.

Hexagonal, rhombohedral. Crystals, compact massive, granular, micaceous and earthy. Color black, red, brown. Streak red and reddish brown. Metallic, submetallic or earthy dull. H=5.5—6.5; G=4.9—5.3.

Hematite is the chief iron mineral and large deposits occur in California awaiting development. It occurs massive black, and massive and earthy red. The crystalline black masses are found in connection with the crystalline metamorphic and igneous rocks while the red earthy masses are sedimentary alterations of iron bearing minerals. Red hematite mixed with brown limonite forms the common gossan capping of iron sulphide deposits. The flaky specular variety, often termed "specularite," is a common constituent of the crystalline rocks of the State.

Martite is a pseudomorph of hematite after magnetite. Much of the magnetite of the State shows a change into hematite and martite is common in the magnetite-hematite deposits.

Alameda County: Massive red earthy hematite mixed with limonite forms the capping of the pyrite body at Leona Heights.

Alpine County: Massive black specimens are common at Monitor.

Amador County: Small amounts occur about two miles west of Ione.

Butte County: Common in the gravels at Magalia, Butte Creek, Oroville and Sterling City.

Calaveras County: Small amounts found at Douglas Flat, Murphy, Wallace and Quail Hill.

Del Norte County: Found at the Kelsey Tunnel, 14 miles southeast of Crescent City.

El Dorado County: Heavy masses at Shingle Springs. In the gravels at Diamond Springs, Green Valley and Virner.

Humboldt County: Large vein 3 miles south of Centerville.

Inyo County: Massive specular hematite occurs at the Defiance mine. Also found in Owens Valley, Hanks[6].

Kern County: At Cane Springs and Ricardo.

Lake County: Massive red near Glenbrook. In Cobb Valley.

Madera County: One of the largest deposits of magnetite-hematite occurs in the Minaret Mountains. Much of this ore is martite.

Marin County: Massive specimens have come from the Maillard Ranch, about two miles southwest of San Geronimo.

Modoc County: Hematite flakes occur along the Feather River.

Mono County: Common mineral in the Blind Spring district.

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Napa County: Massive red occurs near St. Helena. Massive at White Sulphur Springs and Blaisville.

Nevada County: Associated with gold at Meadow Lake, Lindgren[5]. Minor deposits occur at Indian Springs and at Newtown.

Orange County: Observed at Fullerton.

Placer County: Some hematite occurs with magnetite at the Hotaling deposit about six miles north of Auburn. Small amounts occur at Clipper Gap, Red Hill and near Weimar.

Plumas County: With magnetite near Crescent Mills; at Mumford's Hill, Light's Canyon, Genessee Valley and Nelson Point.

Riverside County: Considerable hematite is associated with, and has been formed from, magnetite, at the extensive Eagle Mountain deposit.

San Bernardino County: The numerous iron deposits of the Mojave Desert have hematite and magnetite in heavy black masses. The deposits near Dale, on Iron Mountain, in the Kingston Range, at Cave Canyon, Newberry, on Providence Mountain and elsewhere in the county are massive hematite after magnetite, or martite.

San Diego County: Black massive hematite in Eagle Peak Canyon.

Shasta County: The Redding or Pitt River deposit of hematite has been utilized at the electric smelting furnace at Heroult. The capping of the pyrite beds of this county are thick deposits of earthy hematite and limonite.

Siskiyou County: The gravels of the Shasta River show specular hematite.

Sonoma County: Deposits are reported near Fort Ross and near the west fork of the Guelala river.

Stanislaus County: A foliated variety occurs near La Grange.

Tehama County: Minor deposits occur at Beegum.

Trinity County: In the sands at Trinity Center.

Yuba County: In the sands of the Brownsville district.

98. ILMENITE—Menaccanite—Titaniferous Iron.

Oxide of iron and titanium, $(FeTi)_2O_3$.

Hexagonal, rhombohedral. Plates, massive, in rounded pebbles and grains. Color black. Streak dark brown to black. Metallic luster. H = 5 — 6; G = 4.5 — 5.

Ilmenite resembles hematite and magnetite so closely that it is not often differentiated. The black beach sands and the black concentrates in the gold fields contain much of the mineral in small grains and rolled pebbles. In most of the localities given below it exists in the sands.

Amador County: Near Volcano.

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Butte County: At Oroville, Cherokee, Little Rock Creek, Brush creek, and Inskip.

Calaveras County: San Andreas, Murphy and Wallace in considerable amount.

Del Norte County: At Crescent City.

El Dorado County: In the Brownsville district, at Green Valley, Placerville, Grizzly Flats. Its occurrence is mentioned at Georgetown, Hanks[9].

Humboldt County: At Upper Gold Bluff.

Kern County: A large constituent of the black sands at Vaughn.

Los Angeles County: In the beach sands at Ocean Park.

Madera County: With magnetite in the Minaret Mountains.

Mariposa County: Near Princeton and in dolomite as crystals near Mariposa.

Nevada County: At Rough and Ready, Nevada City, North Bloomfield and Relief Hill.

Orange County: At Fullerton.

Placer County: At Gold Run.

Plumas County: At Spanish Ranch, Crescent Mills, Genessee, La Porte and Nelson Point.

San Bernardino County: Near Needles.

San Francisco County: A constituent of the dikes cutting across the city.

San Luis Obispo County: A constituent of the beach sands of the county.

Santa Barbara County: At Point Sal.

Santa Cruz County: At Aptos.

Shasta County: At Round Mountain, French Gulch and Redding.

Siskiyou County: In the sands of Jackson Creek, Happy Camp, Forks of the Salmon, Sawyers Bar, Scott River and Shasta River.

Trinity County: At Junction City, Carrville, Minersville and on Trinity River.

Tuolumne County: At American Camp.

Yuba County: At Marysville, Brownsville, Yuba River, Strawberry Valley, Indian Hill and Oregon House.

99. SPINEL.

Oxide of aluminium and magnesium, $MgO.Al_2O_3$.

Isometric. Small crystals; rounded grains. Color ruby-red, blue, green, brown and black. Vitreous luster. H=8; G=3.5—4.1.

Spinel occurs only as a rock constituent and exist in some of the gold sands as ruby-red grains resembling red garnet. *Picotite* is a brown

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spinel containing chromium and iron which occurs in the serpentine rocks. *Pleonaste* is an iron-magnesia spinel.

Butte County: Small crystals of ruby spinel have been found in the rock of the diamond mine near Oroville.

Humboldt County: Ruby spinel occurs in the beach sands at Gold Bluff.

Placer County: Picotite has been found at Rocklin, Hanks[6].

San Diego County: Blue spinel was reported to occur in the Mack mine near Rincon; the deep green, pleonaste variety, in small octahedrons, occurs there, associated with garnet, Rogers[3].

San Luis Obispo County: Ruby spinel has been observed near San Luis Obispo, Kunz[7].

Siskiyou County: Picotite occurs in the basalts of Mount Shasta, Hanks[6].

100. MAGNETITE—Magnetic Iron.

Oxide of iron, Fe_3O_4.

Isometric. Octahedral crystals, compact and granular massive. Color iron black. Streak black. Metallic luster. H=5.5—6.5; G=5.1. Strongly magnetic.

Magnetite is one of the most abundant of the iron minerals and good deposits of it occur in the State. It is a constituent of all igneous rocks and in such condition exists in all of the counties. It forms the bulk of the black sands. Most of magnetite occurs with the metamorphic schists and gneisses, and in igneous rocks. Often occurs along the contact of igneous intrusions through metamorphic or sedimentary rocks. Some of the magnetite is titaniferous, grading toward ilmenite.

Lodestone is the variety possessing polarity.

Amador County: Large boulders have been found at Volcano, W. P. Blake[1]. On Sutter Creek.

Butte County: Abundant in the drift workings at Magalia, in the gravels on Butte Creek and in the dredging sands at Oroville. In the concentrates at Sterling City, Little Rock Creek, Brush Creek, Lovelock and Inskip.

Calaveras County: In the concentrates at Douglas Flat, San Andreas, Murphy, and Wallace.

Del Norte County: At Crescent City, Gilbert Creek, on Smith River.

El Dorado County: Massive about two miles northeast of Shingle Springs and also fine octahedrons in chlorite. The lodestone variety has been found at Coloma. Common in the concentrates at Virnir, Green Valley, Grizzly Flats, Reliance mine and in the Brownsville district.

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Fresno County: Lodestone has been found at the Sparkling Iron mine, Kings Creek district.

Humboldt County: The greater part of the black constituent of the beach sands at Gold Bluff and Upper Gold Bluff is magnetite. Common also at Orleans and Trinidad.

Kern County: Abundant at Ricardo, Cane Springs and Vaughn in the black concentrates.

Los Angeles County: Black sands at Ocean Park. Solid masses near Russ Station in Soledad Canyon. Small deposit in canyon about ten miles northeast of Acton; with garnet in the black sands of Santa Monica Bay.

Madera County: Large deposits of magnetite-hematite occur in the Minaret Mountains. Deposits occur on the west slope of Mount Raymond.

Modoc County: In the drift and black sands of the Feather River.

Mono County: Found massive in the Benton, Bodie and Lundy districts, Whiting[1].

Nevada County: A deposit occurs about one mile west of Newtown and also about four miles south of Indian Springs at the contact between granodiorite and diabase. Common in the concentrates at Nevada City, Grass Valley, North Bloomfield, Relief Hill, and Rough and Ready.

Orange County: In the sands at Fullerton.

Placer County: A deposit which has been worked for the electric smelter at Heroult occurs at Hotaling, about six miles north of Auburn, on the contact between diabase and quartzite. Octahedrons are common at Forest Hill. Common in the black sands and concentrates at Butcher Ranch, Michigan Bluff, Gold Run, East Auburn, in Blue Canyon, and on the North Fork of the American River.

Plumas County: Common at Spanish Ranch, Genessee, La Porte, Nelson Point, Crescent Mills, and on Rock Island Hill, but only in small amounts.

Riverside County: One of the largest deposits of iron in the State occurs on Eagle Mountain. It is magnetite-hematite or martite ore.

Sacramento County: In the black sands at Michigan Bar.

San Bernardino County: Important deposits of magnetite occur in several localities in this county but are as yet not utilized. Good deposits on Iron Mountain, near Dale, at Owl Holes, on the Kingston Range, at Cave Canyon, Garlic Springs, Newberry, and on Providence Mountain. The Dale deposit has been described by Harder[2].

San Francisco County: A constituent of the beach sands.

San Luis Obispo County: Common at La Panza.

Santa Barbara County: Common in the beach sands at Point Sal.

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Shasta County: Large deposit at Hotaling on contact between diabase and slate. Deposit near Baird. Occurs with hematite at Iron Mountain and at most of the copper mines. In the sands at French Gulch, Redding and Round Mountain. On contact between diabase and carboniferous limestone at Gray Rock and on McCloud River.

Sierra County: Large beds said to occur in this county, W. P. Blake[9].

Siskiyou County: In the black sands it is common at Happy Camp, Seiard, Cecilville, Forks of the Salmon, Sawyer's Bar, Scott River, Oro Fino, Castella, Shasta River, Beaver Creek, Henley and Klamath River.

Trinity County: In the black sands at Trinity Center, Douglas City, Junction City, Carrville, Minersville and along the Trinity River.

Tulare County: Massive at New Pass, W. P. Blake[1].

Tuolumne County: In the black concentrates at all of the mines.

Yuba County: Common at Marysville, Brownsville, Strawberry Valley, Indian Hill, Oregon House, Camptonville and on Yuba River.

101. CHROMITE—Chromic Iron.

Oxide of chromium and iron, $FeCr_2O_4$.

Isometric. Generally massive. Color black. Streak grayish brown. Metallic luster. H = 5.5; G = 4.32 — 4.57.

In much of the chromite of the State magnesium replaces the iron, forming magnesium chromite. The mineral is formed in serpentine rocks, often as large boulder-like masses and irregular shaped masses. It is abundant in the serpentine areas of the State, and some tons of it are produced annually. It is also abundant in the black sands.

Alameda County: Pockets of massive chromite occur in the serpentine about seven miles northeast of Milton, and at Mendenhall, about sixteen miles south of Livermore.

Amador County: Found near Jackson.

Butte County: A constituent of the black sands at Magalia, Oroville, Cherokee, Buchanan Hill, Lovelock, and Pentz.

Calaveras County: In the serpentine about five miles east of Valley Springs. In the concentrates at Forest Gulch.

Colusa County: Massive at Newville.

Del Norte County: In the black sands of Smith River, on Gilbert Creek and at Crescent City. Good deposits on Rattlesnake Mountain, twenty miles east of Crescent City.

El Dorado County: Near Latrobe, near Colima and at Shingle Springs.

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Fresno County: Found near Madera in masses coated with zaratite. Deposits occur in the southwest part of the county in the Mount Diablo Range, and in the serpentine hills east of Fresno.

Humboldt County: Constituent of the beach sands at Gold Bluff, and of the concentrates at Orleans and Trinidad.

Lake County: Pockets of chromite occur on the Pardee Ranch, near Middleton.

Mendocino County: Found coated with green uvarovite garnet about ten miles north of Willits. Specimens have come from near Ukiah.

Monterey County: Common in small masses in the serpentine of this county, and specimens have been analysed, Goldsmith[3].

Cr_2O_3	Al_2O_3	Fe_2O_3	MgO	CaO	SiO_2	
52.12	2.18	15.24	12.29	5.65	12.12	=99.60 per cent

Nevada County: Fine octahedrons occur in the serpentine near Indian Springs.

In the concentrates at Rough and Ready, North Bloomfield, and Relief Hill.

Placer County: A deposit occurs in serpentine near Green Valley below Towle. In the black sands of the North Fork of American River, of Blue Canyon, at Loomis, and at Michigan Bluff.

Plumas County: Common at Rock Island Hill, La Porte, and in Meadow Valley as concentrates.

Sacramento County: A prominent constituent of the black sands at Michigan Bar.

San Benito County: Massive specimens coated with zaratite have come from near Hollister.

San Luis Obispo County: Mined in mountains southeast of San Luis Valley on the slope of the San Lucia Range. Occurs at the London mine, 4½ miles northeast of San Luis Obispo. Found at the head of Carpojero Creek and at La Panza. The chromite from the Pick and Shovel mine on Chorro Creek has been analysed, Pemberton[1].

Cr_2O_3	Al_2O_3	Fe_2O_3	MgO	FeO	MnO	SiO_2	H_2O	
56.68	11.40	3.52	16.23	11.77	0.15	3.40	0.94	=100.09%

San Mateo County: Common in the beach sands.

Santa Clara County: Found in small masses in the serpentine near Los Gatos and near New Almaden.

Shasta County: At French Gulch and in the black sands of the Sacramento River.

Siskiyou County: A good deposit near Castella. Common in the concentrates at Callahan, Grouse Creek, Happy Camp, on Scott River, Beaver Creek and in Seiard Valley.

Sonoma County: Found at Litton Springs and near Cloverdale.

Trinity County: In the sands at Trinity Center.

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Tuolumne County: Masses have been found near Chinese Camp.

Yuba County: In the black sands at Camptonville, on the Yuba River, and on Indian Hill.

102. CASSITERITE—Tin Stone.

Oxide of tin, SnO_2.

Tetragonal. Twinned crystals and massive. Color brown and black. Streak gray or pale brown. Adamantine to dull luster. H=6—7; G=6.8—7.1.

This valuable oxide, from which practically all of the metallic tin is obtained, is rare in California. A few specimens of stream tin and a small deposit quickly exhausted are all that have been found.

Plumas County: Stream tin was found in the bed of the middle fork of the Feather River, three miles above Big Bar, Hanks[6].

Riverside County: The Temescal tin mine was situated a few miles southeast of South Riverside in the Santa Ana Mountains. The oxide occurred in a rudely semicircular area of granite about two miles in diameter, as brownish masses and reddish brown crystals in a vein of tourmaline and quartz. Some layers of wood tin also occurred. An analysis of a fairly pure specimen of the ore was made by Genth, Fairbanks[5].

SiO_2	WO_3	SnO_2	CuO	$Al_2O_3Fe_2O_3$ MnO CaO
9.82	0.22	76.15	0.27	13.54

San Diego County: Small crystals were found associated with gem tourmaline, beryl and stibiotantalite, at Mesa Grande, Penfield and Ford[1].

Siskiyou County: Stream tin is not uncommon in the gravels at Sawyer's Bar.

Trinity County: Found as stream tin near Weaverville, Hanks[6].

103. RUTILE.

Oxide of titanium, TiO_2.

Tetragonal. Long prisms and grains; crystals often twinned. Color reddish brown to brownish black. Adamantine to metallic luster. Streak pale brown to colorless. H=6—6.5; G=4.18—4.25.

Rutile, as a rock constituent in microscopic crystals, is common in many of the metamorphic rocks of the State. Large crystals have not been found.

Amador County: Reported as needles in quartz, forming sagenite, at Tyler's ranch near Oleta.

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Butte County: A constituent of the gold washings at Cherokee, Silliman[7].

Humboldt County: First noticed in the State in the granite at Eureka.

Mono County: It occurs in small reddish brown crystals in white quartzite with bands of blue lazulite near Mono Lake.

San Diego County: One of the constituents of the dumortierite schist at Dehesa, Schaller[5].

Santa Clara County: Found in the schists of Calaveras Valley and in much of the metamorphics of the Coast Range, Murgoci[1].

104. ANATASE—Octahedrite.

Oxide of titanium, TiO_2.

Tetragonal. Small pyramidal crystals. Cleavage perfect basal and prismatic. Color brown. Adamantine to metallic luster. H=5.5 — 6; G=3.82 — 3.95.

This dimorphic form of the oxide is much rarer than rutile, and is always found in minute crystals.

El Dorado County: Minute crystals with brookite were found implanted on quartz crystals near Placerville, Kunz[1], [2].

105. BROOKITE.

Oxide of titanium, TiO_2.

Orthorhombic. Crystals tabular or pyramidal. Color dark brown to black. Adamantine luster. H=5.5 — 6; G=3.87 — 4.01.

This trimorphic form of the oxide is also much rarer than rutile, and only the one locality is known in the State for its occurrence.

El Dorado County: Found in tabular reddish brown crystals, with anatase on quartz crystals at Placerville. Forms by Penfield: (100), (001), (110), (210), (102), (104), (021), (121), (122), (134), (234), Kunz[1],[2].

106. CHRYSOBERYL.

Oxide of beryllium, $BeAl_2O_4$.

Orthorhombic. Usually twinned crystals. Striated faces. Color grass-green, yellowish green and yellowish brown. Vitreous. H=8.5; G=3.5 — 3.84.

This is a very rare mineral and when of good color is important as a gem stone.

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Butte County: Supposed green specimens of chrysoberyl have been found near Stanwood and at Big Bar. They are probably californite, which occurs in that vicinity.

107. HAUSMANNITE.

Oxide of manganese, Mn_3O_4.

Tetragonal. Small pyramidal crystals, massive, granular. Color brownish black. Streak chestnut-brown. Submetallic luster. H=5—5.5; G=4.72—4.85.

Manganese is abundant in the State, and it is quite possible that this rarer oxide may occur in many of the localities and remain unidentified.

Plumas County: Specimens of hausmannite have come from Meadow Valley.

108. MINIUM—Red Lead.

Oxide of lead, Pb_3O_4.

Powder. Color bright red mixed with yellow. Streak orange-yellow. G=4.6. Dull luster.

The red oxide of lead rarely is found native. It is an oxidation product of galena and other lead minerals, occurring as a powder.

Kern County: Specimens have come from near Fort Tejon.

Tulare County: A small amount of red lead was found in the northern part of the county.

109. CREDNERITE.

Oxide of manganese and copper, $Cu_3Mn_4O_9$.

Monoclinic. Foliated masses. Cleavage perfect basal. Color iron-black to steel-gray. Streak brownish black. Metallic luster. H=4—5; G=4.95.

This is a very rare mineral and its occurrence in the State is limited to one locality.

Napa County: Found massive near Calistoga.

110. BRAUNITE.

Silico-oxide of manganese, $3Mn_2O_3.MnSiO_3$.

Tetragonal. Small pyramids and massive. Color brownish black. Streak brownish black. Submetallic luster. H=6—6.5; G=4.75.

Silicious manganese ores are very common in California, and it is probable that the rather common brown manganese exists in many of the localities, but it has never been reported.

Plumas County: Specimens of braunite have come from Meadow Valley.

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111. PYROLUSITE.

Oxide of manganese, MnO_2.

Orthorhombic. Generally fibrous or as a powder. Color black. Streak dull-black. Metallic to dull luster. H=2—2.5; G=4.82.

Pyrolusite is a very common mineral generally associated with other ores of manganese. It is usually found as fibrous seams and coatings in masses of psilomelane, and often grades toward manganite. Common as dendritic coatings.

Alameda County: It occurs with psilomelane in the Diablo Range, southwest of Livermore in the Corral Hollow district.

Amador County: Found in the Seaton mine and on volcanic ash at Volcano.

Calaveras County: Occurred at Wild Rose Flat near Murphy.

Colusa County: Found at Stony Ford in association with cinnabar.

Contra Costa County: Occurred with psilomelane on Red Rock, San Francisco Bay.

El Dorado County: In dendritic coatings near Placerville and fibrous at Greenwood.

Marin County: Small amounts found in the rock at Sausalito.

Mendocino County: At Red Mountain.

Napa County: Pyrolusite occurred as radiate concentric masses with cinnabar at the old Redington and Manhattan mines, Knoxville.

Nevada County: Found in the Grass Valley district, Lindgren[6]. Also at Sweetland, and as dendrite on rocks of Sugar Loaf Hill.

Placer County: Found near Auburn.

Plumas County: Common in the Diadem lode, Meadow Valley district.

Riverside County: Occurs near Elsinore.

San Bernardino County: One of the minerals in the Calico and Barstow districts.

San Joaquin County: In the manganese deposits of the Diablo Range.

San Mateo County: At Baden.

Santa Clara County: Found at the Washington mine and in mines of the Diablo Range.

Sierra County: Common as dendrite at Alleghany.

Siskiyou County: Occurs with rhodonite at Sawyer's Bar.

Sonoma County: At the Shaw mine.

Tuolumne County: Common with psilomelane at Knapp's ranch, near Columbia.

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112. MANGANITE.

Hydrous oxide of manganese, $Mn_2O_3.H_2O$.

Orthorhombic. Crystals long prisms. Structure usually columnar. Perfect brachypinacoidal cleavage. Color iron-black. Metallic luster. Streak dark reddish brown. H=4; G=4.3.

There are numerous small deposits of manganese in the State, and much of the ore appears to be maganite mixed with a more or less silicious psilomelane. The deposits consist generally of black porous ore in masses and lenses of red and brown jasper in the metamorphics of the Coast ranges, and to some extent in the Sierras. Reports on the deposits of the State have been made by Penrose[1] and by Harder[1].

Alameda County: Deposits occur in the Livermore-Tesla district southwest of Livermore in the Diablo Range. The ore is in jasper lenses, and much of the manganese produced in the State has come from this district, one of the earliest and best known mines being the old Ladd or Corral Hollow mine.

Calaveras County: Some manganite with psilomelane occurs two miles northeast of San Andreas in mica schist.

Colusa County: Small deposits on the east flank of St. John Mountain, near Little Stony.

Contra Costa County: The deposits on Red Rock Island in San Francisco Bay contain some manganite with the psilomelane.

Marin County: Some manganite is found in the red rock near Sausalito.

Mendocino County: At the Cave mine, ten miles northeast of Ukiah.

Placer County: Small pieces have been found near Colfax.

Plumas County: Considerable manganese occurs in this county in the Meadow Valley and other districts, and manganite is probably common.

Riverside County: Psilomelane and manganite occur in a network of veins in schist six miles northeast of Elsinore, in the Maria Mountains.

San Joaquin County: Some small deposits in jasper in the Diablo Range.

San Luis Obispo County: Small deposits occur five miles west of San Luis Obispo.

Santa Clara County: In the Black Wonder and other mines of the Diablo Range.

Sonoma County: At the Shaw mine eight miles northwest of Cloverdale.

Tuolumne County: Occurs with rhodonite two miles north of Sonora.

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113. GÖTHITE.

Hydrous oxide of iron, $Fe_2O_3.H_2O$.

Orthorhombic. Slender prisms, vertically striated. Cleavage perfect brachypinacoidal. Color yellowish brown. Streak yellowish brown. Adamantine to submetallic luster. H=5—5.5; G=4.37.

Göthite is usually found as slender prismatic crystals in masses of limonite or hematite, and resembles limonite so closely that it would be usually classed as such.

Inyo County: Found with chrysocolla and limonite at the St. Ignacio mine.

Mariposa County: Observed at Burns Creek in masses of limonite.

San Bernardino County: An associate with limonite at the magnetite-hematite deposit, near Dale.

114. LIMONITE—Brown Hematite.

Hydrous oxide of iron, $2Fe_2O_3.3H_2O$.

Massive. Compact, stalactitic, botryoidal, columnar, fibrous, earthy. Color yellow, brown to black. Streak yellowish brown. Submetallic to dull luster. H=5—5.5; G=3.6—4.

Limonite is the most common of the iron minerals, and is quite universal in its occurrence as a staining material. It is found varying from soft yellow and brown ocher to hard compact masses. As the common alteration product of pyrite and most minerals containing iron, it is prevalent in most mineral districts and forms the gossan and brown capping of ore deposits. Cubes of limonite as pseudomorphs after pyrite are common in mining regions. As an ore of iron it is not so valuable as hematite or magnetite. It is present in every county in some form and only a few of its occurrences can consequently be cited.

Alameda County: Earthy limonite mixed with hematite is common as a gossan capping of the pyrite deposit at Leona Heights.

Amador County: Found in concretions and earthy masses at Pine Grove. With hematite and magnetite at Volcano.

Butte County: Large blocks at Burns Creek, W. P. Blake[9]. Thick masses at the Monarch mine; cubes at Red Hill and at Magalia.

Calaveras County: Forms capping of hill about one mile and a half north of Murphy. The Detert deposit near Valley Springs was formerly worked. Massive and yellow ocher at the Eureka mine, near Valley Springs.

Inyo County: Pseudomorphs after long prisms of stibnite from the Cerro Gordo.

Mariposa County: Fine large cubes have come from the Chowchilla Valley.

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Placer County: At Gold Run.

Plumas County: Massive in Light's Canyon and at Nelson Point.

San Luis Obispo County: Brown banded masses have come from the Perfumo ranch. This deposit lies in the Los Osos Mountains interbedded with Franciscan shales and sandstones.

Shasta County: Common as cappings of the pyrite deposits of the county.

Pseudomorphs after hedenbergite have been found at Ydalpan. Highly iridescent specimens have come from Copper City. Excellent bronze colored stalactites occurred at the Lost Confidence mine, Iron Mountain.

Sonoma County: Yellow ocher at the Occidental mine.

Tulare County: Common in the Mineral King district.

Yolo County: In the sands at Capay.

115. BAUXITE.

Hydrous oxide of aluminium, $Al_2O_3.2H_2O$.

Massive, earthy, öolitic. Color white, yellow, red or brown. H=1.5; G=2.55.

Deposits of pure bauxite are unknown in the State. Aubury[3] is the authority for the occurrence of the mineral.

Riverside County: Said to occur in the county.

Yuba County: Found at Smartsville.

116. BRUCITE.

Hydrous oxide of magnesia, $MgO.H_2O$.

Hexagonal, rhombohedral. Foliated plates and fibrous masses. Cleavage perfect basal. Color white, gray, pink. Pearly luster. H=2.5; G=2.38—2.4.

Brucite occurs as thin veins in serpentine, but very little has been observed in the State as an alteration of serpentine. It also occurs as a metamorphic mineral in crystalline magnesian limestone.

Riverside County: Brucite is abundant in small globular masses in the white crystalline limestone at Crestmore, formed probably as a hydration product of original periclase. An analysis by Eakle gave:

MgO	Fe_2O_3	H_2O	
67.48	0.55	31.73	99.76 per cent

San Francisco County: A small amount of brucite has been observed as thin seams in the serpentines of San Francisco.

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117. SASSOLITE—Boracic Acid.

Hydrous oxide of boron, $B_2O_3.3H_2O$.

Triclinic. Usually in small scales. Cleavage perfect basal. Color white. Pearly luster. H=1; G=1.48.

The waters of some of the springs and lakes of the State contain traces of boracic acid, but the scaly white crystals of the solid sassolite have not been found.

Lake County: Occurs in the waters of Clear Lake, W. P. Blake[9].

San Bernardino County: Some of the borate waters of this county yield the oxide upon evaporation.

118. PSILOMELANE.

Hydrous oxide of manganese, usually impure.

Massive, botryoidal, stalactitic. Prominent conchoidal fracture. Color black. Streak brownish black. H=5—6; G=3.7—4.7.

This is the most common manganese mineral and is the chief ore of manganese in the State. It is almost always associated with manganite or pyrolusite, and often with limonite. The mineral is found in many localities, but the characteristic occurrence of the more important deposits is in seams and irregular masses in jasper. All of the localities cited for pyrolusite and manganite contain psilomelane as well.

Wad is an impure soft black oxide, often with the harder psilomelane.

Asbolite is a wad containing cobalt.

The locations of manganese claims in the State are given by Aubury[3]. Reports on the manganese deposits of the State have been made by Penrose[1] and by Harder[1].

Alameda County: The Corral Hollow deposit is largely silicious psilomelane.

Contra Costa County: The deposit of manganese on Red Rock, San Francisco Bay, which was formerly mined, is psilomelane.

Los Angeles County: Asbolite occurred in the O K mine, San Gabriel Canyon.

Marin County: Large masses occurred on the San Geronimo ranch.

Nevada County: Wad occurs near the North Banner mine.

Placer County: Masses at Michigan Bluff.

Plumas County: Large masses on Mumford Hill.

San Benito County: Stringers and coatings occur with the benitoite, Louderback[2].

Tuolumne County: Massive with pyrolusite near Columbia.

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CHAPTER VII.

CARBONATES.

Anhydrous.
Calcite
Dolomite
Ankerite
Magnesite
Siderite
Rhodochrosite
Smithsonite
Aragonite
Strontianite
Cerussite
Bismutosphaerite
Phosgenite
Northupite
Tychite
Hydrous.
Malachite
Azurite
Aurichalcite
Hydrozincite
Dawsonite
Thermonatrite
Gay Lussite
Natron
Trona
Pirssonite
Hydromagnesite
Hydrodolomite
Zaratite
Bismutite

119. CALCITE—Calc Spar—Limestone.

Carbonate of calcium, $CaCO_3$.

Hexagonal, rhombohedral. Crystals common, rhombohedrons and scalenohedrons. Also massive, granular, stalactitic, chalky. Cleavage perfect rhombohedral. Colorless, white, yellow, brown, blue, red, pink, green, black, etc. Vitreous luster. H=3; G=2.71.

Calcite is one of the exceedingly common minerals and occurs in many colors and in many varieties based on color and structure. Some of these varietal names are: *iceland spar, dogtooth spar, stalactite, stalagmite, marble, onyx marble, travertine, calc-tufa, chalk* and common limestone. Extensive beds of limestone are common in the State, and are quarried for the manufacture of cement. Fine quality marble is also known, but little of it is quarried except for cement. Aubury[3] gives the location of limestone quarries.

Alameda County: Crystals are common in the chalcedony geodes on the Berkeley Hills.

Alpine County: Fine groups of rhombohedrons have come from the Pennsylvania mine.

Amador County: White marble near Plymouth.

Butte County: A black mottled marble is found at Pentz.

Calaveras County: Crystals occur near Natural Bridge.

El Dorado County: Fine stalactites occur at the Alabaster Cave. Good crystals found at the Cosumnes copper mine.

Inyo County: Thick deposits of beautiful variegated marble occur at the foot of the Inyo Mountains, between Keeler and Lone Pine. The marble is dolomitic. Fine crystal specimens and stalactites have been found at the Cerro Gordo and Union mines.

Kern County: Good quality marble occurs on the Tehachapi Range near Neenach.

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Los Angeles County: Calcite crystals occur with the colemanite at Lang with the forms: $(10\bar{1}0)$, $(01\bar{1}2)$, $(09\bar{9}5)$, $(02\bar{2}1)$, (0001).

Mariposa County: Good crystals have come from the mines near Mariposa.

Merced County: A strontian-bearing calcite is said to occur at Delhi.

Mono County: A large deposit of travertine occurs near Bridgeport. Good crystals have come from the Bodie district.

Nevada County: Common in the Grass Valley and Nevada City mines. Fine scalenohedrons have come from the Pittsburg mine.

Placer County: One of the minerals of the Ophir district, Lindgren[5]. A verd-antique variety was found about sixteen miles northeast of Auburn.

Riverside County: Blue calcite occurs at Crestmore, which is quarried for cement manufacture.

San Benito County: Found in the rocks adjoining the benitoite veins near the headwaters of the San Benito River, Louderback[2].

San Bernardino County: A large deposit of beautiful variegated marble occurs at the Gem Marble quarries in the Silver Mountain district about five miles south of Oro Grande which is now quarried for cement. Also on Slover Mountain, near Colton, gray limestone is quarried for cement.

San Francisco County: Sealenohedrons of calcite occur at Fort Point. They have the forms: $(53\bar{8}2)$, $(23\bar{5}8)$, $(4.16.\bar{2}0.3)$, $(1.6.\bar{7}.13)$, Schaller[8].

San Luis Obispo County: Beautiful onyx marble with moss-like inclusions of greenish chlorite imparting a landscape effect to the translucent thin slabs..

San Mateo County: Crystals have come from near San Pedro.

Shasta County: Large stalactites and tubular shapes occur in Potter's Cave, near Baird, Eakle[6].

Siskiyou County: Large deposits of white and variegated marble occur on Marble Mountain.

Solano County: Onyx marble and massive limestone occurs near Tolenas. A brown banded onyx marble occurred near Suisun.

Sonoma County: Low rhombohedrons of calcite occur in geodes near Petaluma.

Tuolumne County: White and blue-veined marble occurs in an extensive deposit on the Stanislaus River a few miles north of Columbia. Fine crystals with the forms $(10\bar{1}0)$, $(01\bar{1}1)$, and $(3\bar{1}\bar{2}1)$ were found at the Keltz mine. Large stalactites at the Crystal Palace Cave near Columbia.

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120. DOLOMITE—Magnesium Limestone.

Carbonate of magnesium and calcium (Ca,Mg) CO_3.

Hexagonal, rhombohedral. Crystals usually with curved faces and massive. Cleavage perfect rhombohedral. Color white, gray, brown, pink. H=3.5—4; G=2.88.

Dolomite is a common mineral, but is not so abundant as calcite. Much of the limestone and marble of the State is dolomitic, and some is doubtless pure dolomite, but the amount and localities are unknown since the two carbonates are only chemically differentiated. The mineral is commonly associated with magnesian silicates, especially the serpentine rocks, in which it is often found as white veins.

Calaveras County: White crystals of dolomite occurred in the gold-bearing schist of Carson Hill.

Inyo County: The variegated marbles of the Inyo Mountains are dolomitic. Good crystals were found in the San Felipe mine.

Nevada County: Dolomite occurs as veins in the serpentine at Nevada City.

Santa Clara County: Large specimens of drusy crystallizations and low rhombohedrons of snow-white dolomite occurred in the New Almaden and Guadalupe quicksilver mines.

121. ANKERITE.

Carbonate of calcium, magnesium and iron, $CaCO_3.MgCO_3.FeCO_3$.

Hexagonal, rhombohedral. Generally massive. Cleavage like calcite. Color white to brown. H=3.5—4; G=2.95—3.1.

Ankerite is sometimes classed as an iron-bearing dolomite. It is a very common form of carbonate associated with the gold-bearing schists of the Mother Lode region, especially with the green mica, mariposite.

Mariposa County: The mineral was first reported by Silliman[5] as an associate of mariposite on the Mariposa Estate. It was prominent in mariposite schists at the Josephine mine.

Tuolumne County: Common on Quartz Mountain and at the Rawhide Ranch mine, near Tuttletown.

122. MAGNESITE.

Carbonate of magnesia, $MgCO_3$.

Hexagonal, rhombohedral. Crystals are rare. Generally compact massive; sometimes earthy. Color snow-white to brown. Prominent conchoidal fracture, of massive mineral. H=3.5—4.5; G=3.0—3.12.

Magnesite is a very common mineral in California because of the great areas of serpentine from which it is an alteration product. It is characteristic of the serpentinized rock to be intersected by veins and

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patches of the snow-white to light buff carbonate, some of these veins forming important deposits of the mineral. The main deposits lie in the serpentine belts of the Coast Ranges, but minor deposits also occur in the serpentines of the Sierras. The mineral is almost uniformly in cryptocrystalline masses with prominent conchoidal fracture, and the silicious varieties are very hard. A bulletin on the magnesite deposits of the State has been issued by Hess[2] who gives the analyses cited below.

Alameda County: Small veins occur in the serpentine on Cedar Mountain, about twenty-two miles southeast of Livermore.

Calaveras County: Veins occur near San Andreas.

Fresno County: A very pure magnesite occurs in veins on Kings River, nine miles east of Sanger.

Kern County: Some veins are found near Walker's Pass, east of Bakersfield.

Mendocino County: Pure white veins on Hixon ranch, about twelve miles north of Cloverdale.

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
0.41	0.28	0.12	0.03	47.16	51.88	=99.88 per cent

Napa County: A large number of veins occur in the serpentine of the county. Very prominent in Chiles Valley, about thirteen miles from Rutherford. Analyses of the mineral from this locality gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	H_2O	
2.15	1.22	1.16	5.28	41.01	48.72	--	= 99.54 per cent
1.81	0.08		tr.	46.55	51.25	0.32	=100.01
6.68	15.10	--	--	37.20	40.98	--	=99.96

Veins also occur on the east side of Pope Valley, in Soda Creek Canyon, and in the serpentine of Beryessa Valley.

Nevada County: Narrow veins occur in the serpentine at Nevada City.

Placer County: Veins occur near Damascus and Michigan Bluff and at Gold Run.

Riverside County: Veins are found in a hill of serpentine, about three miles south of Winchester, which are worked for cement purposes.

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
4.73	0.12	0.08	0.43	44.77	49.40	=99.53 per cent

San Francisco County: Small veins occur in the serpentine at Fort Point.

San Luis Obispo County: Small veins on the Kiser ranch about nine miles northwest of Cambria.

Santa Barbara County: Some veins exist in the mountains back of Santa Barbara.

Santa Clara County: Large veins exist in the Diablo Range in the

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northeast corner of the county. An analysis of quite pure magnesite from the Alameda claim gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
0.73	0.14	0.21	0.40	46.61	51.52	=99.61 per cent

An analysis of buff-colored silicious magnesite from the Cochrane ranch, about four miles from Morgan Hill Station, gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
49.85	3.45	0.18	0.48	21.53	23.96	=99.45 per cent

Analysis of the mineral from veins in serpentine near Coyote gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
0.30	0.16	0.38	1.34	45.86	51.80	=99.74 per cent

Sonoma County: There are numerous veins in the serpentine of the county, and Hess gives several analyses. 1. Veins four miles north of Cloverdale called the Creon deposit; 2. Eckert ranch, near Cloverdale; 3. William Creek deposit on steep west side of creek, about seven miles northwest of Guerneville; 4. Red Slide deposit in valley of East Austin Creek, about eight miles north of Cazadero.

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
1.	1.60	0.25	1.09	1.04	45.20	50.43	=99.61 per cent
2.	0.51	1.98	0.16	0.59	45.84	50.80	=99.88
	0.23	0.04	0.20	0.19	46.88	51.57	=99.11
3.	3.51	1.10	0.80	1.46	43.65	49.16	=99.68
4.	7.67	0.26	0.29	0.04	48.42	48.08	=99.76

Stanislaus County: The veins of the American Magnesite Company extend across the line from Santa Clara County.

Tulare County: A large amount of magnesite has been mined from veins on hills about four miles northeast of Porterville. Hess gives several analyses of the mineral from this county. 1. From the serpentine hills near the chrysoprase locality, about eight miles southeast of Porterville; 2. On range of hills about four miles northeast of Porterville; 3. From veins on South Fork of Tule River.

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
1.	0.31	0.11	0.08	0.24	47.22	51.64	=99.60 per cent
2.	2.28	0.03	0.26	1.32	45.17	50.74	=99.80
	0.90	0.49		1.49	44.39	50.06	
3.	0.80	0.42	0.20	1.02	45.94	51.30	=99.68

Small veins also occur in Round Valley, about four miles east of Lindsay; on Rocky Hill, about two miles east of Exeter, with californite; near Naranjo with white opal; and near Auckland.

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123. SIDERITE—Spathic Ore.

Carbonate of iron, $FeCO_3$

Hexagonal, rhombohedral. Crystals with curved faces, also massive. Cleavage perfect rhombohedral. Color ash-gray to dark brown. Vitreous to pearly luster. H=3.5—4; G=3.8.

The iron carbonate is occasionally found in the mining regions in drusy crystallizations associated with pyrite and galena, but the mineral does not appear to be very common in the State.

Inyo County: Small masses have been found at the Custer mine, Coso district.

Los Angeles County: Some massive siderite occurs in the Tejunga Canyon.

Shasta County: According to Fairbanks[2] siderite occurs in large masses in this county east of the Stillwater region.

124. RHODOCHROSITE.

Carbonate of manganese, $MnCO_3$.

Hexagonal, rhombohedral. Small crystals and massive. Cleavage perfect rhombohedral. Color rose-red. Vitreous luster. H=3.5—4.5; G=3.45—3.60.

Few good specimens of the rose-red carbonate have been found in the State. The mineral is generally found in gold-silver regions where manganese is associated with the veins.

Butte County: The mineral has been found on the North Fork of the Feather River.

Placer County: Small druses of the mineral have been found in some of the mines of the county.

San Bernardino County: Good specimens occur at the New York mine near Manvel.

125. SMITHSONITE—Dry Bone.

Carbonate of zinc, $ZnCO_3$.

Hexagonal, rhombohedral. Drusy crystals and massive; often bone-like. Color grayish, bluish, greenish. Vitreous luster. H=5; G=4.45.

Smithsonite is a secondary mineral more often found in silver-lead districts. It is usually associated with lead carbonate and the silicates of zinc.

Inyo County: Found with cerrusite at the Modoc mine, Cerro Gordo, Hanks[6].

Present also at the Ignacio mine with calamine and willemite.

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Kern County: Occurred in drusy veins at the Jewett mine on Cottonwood Creek.

San Bernardino County: With calamine at the Cuticura mine, near Daggett.

126. ARAGONITE.

Carbonate of calcium, $CaCO_3$.

Orthorhombic. Slender prisms, acicular, fibrous, stalactitic, massive. Colorless, white, yellow, brown. Vitreous luster. H=3.5—4; G=2.93—2.95.

The distinction between calcite and aragonite has seldom been made, and much of the banded onyx marble of the State has been erroneously called aragonite. The fine snow-white branching stalactitic form of aragonite, called *"flos ferri,"* is exceptional in its occurrence in the State.

Calaveras County: Fine stalactites of "flos ferri" have come from a cave near Murphy.

Colusa County: Found with sulphur at Sulphur Creek.

Placer County: Said to occur at Gold Run.

San Benito County: Occurs in the rocks adjoining the benitoite veins as radiate bunches and stringers near the headwaters of the San Benito River, Louderback[2].

San Bernardino County: Said to have occurred with priceite, Silliman[8], probably from Calico. Occurs with calcite in the limestone of Slover Mountains near Colton.

San Francisco County: Found as thin veins in the serpentine of Fort Point, Eakle[1].

Solano County: Some aragonite is formed at the Tolenas Springs.

Tuolumne County: Occurs as bunches in the basaltic rock of Table Mountain.

127. STRONTIANITE.

Carbonate of strontium, $SrCO_3$.

Orthorhombic. Columnar masses, fibrous, granular. Cleavage prismatic. Color white, pale green, yellowish. Vitreous luster. H=3.5—4; G=3.68—3.71.

The strontia compounds are very rare in the State, and the carbonate has only been found in one locality.

Plumas County: Large masses of divergent columnar strontianite were found in the Genessee Valley.

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128. CERUSSITE.

Carbonate of lead, $PbCO_3$.

Orthorhombric. Platy crystals. Generally massive. Color gray, cream-white, brown. Adamantine to vitreous luster. H=3 — 3.5; G=6.46 — 6.57.

The carbonate of lead is a common alteration product of galena, and in all mines carrying much lead sulphide it is to be found in the oxidized portion of the veins. It generally occurs as heavy gray or brown masses, but is occasionally found in cream-white platy crystals in the porous ore and galena cavities. In silver districts it is frequently rich in silver and forms the chief ore.

Inyo County: Large crystals were found in the Russ district, W. P. Blake[9].

A common mineral in the Cerro Gordo and other silver districts of the county.

Mono County: Common in the Blind Springs district, Goodyear[1].

San Bernardino County: In the hornsilver districts of Calico and Barstow the lead carbonate was a very prominent mineral, Lindgren[1], Storms[1].

Very prominent in the Silver Reef district near Oro Grande.

129. BISMUTOSPHAERITE.

Carbonate of bismuth, Bi_2CO_5.

Concentric globular with radiating fibers. Color bright yellow to brown. H=3 — 3.5; G=7.30.

This very rare mineral is formed by the alteration of bismuth minerals, and is always secondary.

San Diego County: Occurs in grayish black masses and as a yellow powder from the alteration of native bismuth at Pala, Schaller[4].

130. PHOSGENITE.

Chlorocarbonate of lead $(PbCl)_2CO_3$.

Tetragonal. Prismatic crystals. Color white to yellow. Adamantine luster. H=2.5 — 3; G=6.

This is a very rare lead compound, and but one locality in the State is known for its occurrence.

Inyo County: A specimen was found of acicular, straw-yellow crystals in quartz at the Silver Sprout mine, Hanks[6].

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131. NORTHUPITE.

Double carbonate of sodium and magnesium with sodium chloride.
$Na_2CO_3.MgCO_3.NaCl$.

Isometric. Octahedral crystals. Colorless to brownish. Vitreous luster. H=3.5—4; G=2.38.

Northupite is a new mineral, only known to occur in this State.

San Bernardino County: Some small dirty white and dark brown octahedrons of the combined carbonates and chloride were discovered in 1895 at Searles Borax Lake and named by Foote[1]. An analysis was made by Pratt[1].

CO_2	Cl	SO_3	MgO	Na_2O	H_2O	Insol.	O for Cl
35.12	14.10	0.08	16.08	36.99	0.72	0.22	=100.31—3.16=100.15 per cent

132. TYCHITE.

Double carbonate of sodium and magnesium with sodium sulphate,
$2MgCO_3.2Na_2CO_3.Na_2SO_4$.

Isometric. Small octahedral crystals. Color white. Vitreous luster. H=3.5—4; G=2.58.

This new mineral was found with northupite, and likewise is only known from the one locality.

San Bernardino County: A few small octahedrons of the combined carbonates and sulphate were mixed with the northupite crystals and discovered in 1905 and named by Penfield and Jamieson[1].

SO_3	CO_2	MgO	Na_2O	
15.08	33.55	15.83	35.49	=99.95 per cent
15.06	33.45	15.77	35.65	=99.93

133. MALACHITE—Green Copper.

Basic carbonate of copper, $CuCO_3.Cu(OH)_2$.

Monoclinic. Fibrous, radiating tufts, botryoidal, stalactitic. Color green. Streak green. Vitreous luster. H=3.5—4; G=4.

Malachite is to be found practically in every locality where there is the least trace of copper, as it is the common alteration mineral of copper compounds. As an indication of the presence of copper, it occurs in green coatings and stains, and in the oxidized portion of copper veins it often forms beautiful drusy and velvety crystallizations. Azurite is often associated.

Amador County: Fine reniform masses have come from Volcano.

Calaveras County: Frequently seen at Campo Seco and Copperopolis, but more as stains than as good specimens. Fine specimens came from the old Hughes mine, W. P. Blake[9].

Inyo County: Good drusy malachite occurred in the Cerro Gordo district.

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Mariposa County: Fine drusy coatings were found in the White Rock mine.

Mono County: Common alteration mineral in the Blind Springs district.

Plumas County: Good specimens associated with bornite and chalcocite occur in Light's Canyon.

San Bernardino County: One of the minerals found in the Calico district; also quite common in the oxidized copper ores of the eastern part of the county.

134. AZURITE—Blue Malachite.

Basic carbonate of copper, $2CuCO_3.Cu(OH)_2$.

Monoclinic. Good crystals, massive, earthy. Color deep azure-blue. Streak light blue. Vitreous to adamantine luster. H=3.5—4; G=3.77—3.83.

The blue azurite is not so common as the green malachite with which it is usually found. It occurs generally in aggregates of distinct crystals, often lining cavities in limonitic and malachitic masses. Most copper districts may have some azurite formed as an oxidation mineral.

Calaveras County: Fine crystals occurred with malachite at the old Hughes mine, W. P. Blake[9].

Mono County: Crystals on limonite from the Diana mine had the forms: (001), ($\bar{1}02$), (012), (011), (110), (111), Jackson[3].

135. AURICHALCITE.

Basic carbonate of zinc and copper, $2(Zn,Cu)CO_3 3(Zn,Cu)(OH)_2$.

Monoclinic. Plumose, tabular, laminated. Color pale green, bluish green. Streak like color. Pearly luster. H=2; G=3.54—3.64.

This is a very rare secondary mineral, and has only been found in one locality in the State.

Inyo County: Plumose aggregates and long prismatic crystals associated with calamine and chrysocolla occurred in specimens from the Cerro Gordo mine. Has been mentioned from this locality by Rogers[5].

136. HYDROZINCITE.

Basic carbonate of zinc.

Massive and earthy. Generally as incrustations. Snow-white color. Dull luster. H=2—2.5; G=3.58—3.8.

Hydrozincite is formed as a secondary mineral from the alteration of sphalerite. It is rare in the State.

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Inyo County: Thick layers of the white carbonate occur at the Cerro Gordo mine with sphalerite, willemite and calamine; has been mentioned from this locality by Rogers[5].

137. DAWSONITE.

Basic carbonate of aluminium and sodium, $Na_3Al(CO_3)_3.2Al(OH)_3$.
Monoclinic. Incrustations. Color white. Vitreous luster. H=3; G=2.4.

Dawsonite is a very rare mineral, and occurs in arid regions as white crusts.

Inyo County: Reported to occur as a soft incrustation in a dike in Amargosa Canyon, Bailey[1].

138. THERMONATRITE.

Hydrous carbonate of sodium, $Na_2CO_3.H_2O$.
Orthorhombic. Usually as efflorescences. Color white, yellowish. Vitreous luster. H=1—1.5; G=1.5—1.6. Taste alkaline.

This is a very rare mineral which forms as efflorescences in arid regions.

Inyo County: Forms white efflorescent coatings in Death Valley, according to Bailey[1].

139. GAY LUSSITE.

Hydrous carbonate of calcium and sodium, $CaCO_3.Na_2CO_3.5H_2O$.
Monoclinic. Flat wedge-shaped crystals. Cleavage perfect prismatic. Color white. Vitreous luster. H=2—3; G=1.93—1.95.

This double carbonate is frequently formed on the shores of soda lakes in flat wedge-shaped crystals. Found only in dry regions.

Mono County: Found in crystals on the shore of Mono Lake.

San Bernardino County: One of the minerals of the Searles Borax Lake, Hanks[10]. The forms on the crystals from this lake as determined by Pratt [1] are: (010), (001), (110), (011), ($\bar{1}$01), ($\bar{1}$12). Bailey[1] mentions it as occurring at the Owl Springs niter beds.

140. NATRON.

Hydrous carbonate of sodium, $Na_2CO_3.10H_2O$.
Monoclinic. Exists only in solution or mixed with trona. Tabular crystals obtained by the evaporation of waters from soda lakes. Color white. Vitreous luster. H=1—1.5; G=1.42—1.46. Taste alkaline.

The normal carbonate of soda has not been found in native state, but it exists in solution in some of the lakes and springs of the State.

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Crystals of the carbonate, mixed with the bicarbonate, are obtained by evaporating the water of Owens Lake and other soda lakes of Death Valley and San Bernardino County. The solid contents of Owens Lake have been analysed by Foster[1] and Chatard[1].

141. TRONA—Urao.

Hydrous bicarbonate of sodium, $Na_2CO_3.HNaCO_3.2H_2O$.

Monoclinic. Slender crystals and fibrous masses. Cleavage perfect orthopinacoidal. Color white. Vitreous luster. H=2.5—3; G=2.11—2.14. Taste alkaline.

The bicarbonate is the common form of soda found in lakes and springs. In dry protected localities it exists as crystals and finely fibrous coatings.

Mono County: The solid contents of the waters of Owens Lake are mainly trona, and the mineral occurs along the shores in white layers. Chatard[1] analyses of the solid matter of this lake show it to be over 90 per cent pure soda.

San Bernardino County: Soda is quite common in this county at the various sinks and borate lakes. At Searles Borax Lake it is the material mined, and large amounts of it have been accumulated. Thick layers of solid trona occur with the borax, hanksite, thenardite, glauberite and other salts. Crystals are very common. They are elongated right and left, and have the forms: (100), (001), (101), ($\bar{3}02$), (111), ($\bar{1}11$), ($\hat{2}11$), Ayers[2].

142. PIRSSONITE.

Hydrous double carbonate of calcium and sodium, $CaCO_3.Na_2CO_3.2H_2O$.

Orthorhombic. Hemimorphic crystals. Colorless to white. Vitreous luster. H=3—3.5; G=2.352.

Pirssonite is a mineral discovered in California in 1896 and only known from the one locality.

San Bernardino County: Good hemimorphic crystals of this salt were found with northupite and borax at the New Well, Searles Borax Lake, and the mineral was described and named by Pratt[1]. Forms: (010), (110), (111), (11$\bar{1}$), (131), (311).

CO_2	CaO	Na_2O	K_2O	H_2O	Al_2O_3	SiO_2	
36.07	23.38	25.70	0.15	14.73	0.13	0.29	=100.45 per cent

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143. HYDROMAGNESITE—Hydrodolomite.

Hydrous carbonate and hydrate of magnesium, $3MgCO_3.Mg(OH)_2.3H_2O$.

Monoclinic. Generally massive chalky. Color white. Vitreous, silky to dull luster. H=3.5, crystallized; G=2.14 — 2.18.

Soft white veins of a hydrated magnesite have been found in the serpentine, but most of these veins are classed as magnesite.

Alameda County: A specimen of hydromagnesite from Livermore was analysed by Gutzkow[1].

$SiO_2Al_2O_3Fe_2O_3$	CaO	MgO	CO_2	H_2O	Moisture
1.25	tr.	43.00	36.30	18.70	0.75

Inyo County: Said to occur in chalky and mealy crusts in spots along the Amargosa River, Bailey[1].

Riverside County: Crystals of hydromagnesite occur in the calcite at Crestmore as an alteration product of brucite.

San Francisco County: Small white veins are found in the serpentine of San Francisco.

San Luis Obispo County: Small veins found in the rocks near Port Harford.

The white veins in the serpentine of San Francisco are in part hydrolomite and in part hydromagnesite.

144. ZARATITE.

Hydrous carbonate of nickel, $NiCO_3.2Ni(OH)_2.4H_2O$.

Incrustations. Massive. Color emerald green. Streak green. Vitreous luster. H=3; G=2.57 — 2.69.

The emerald green nickel carbonate is always accompanied by chromite, occurring as an incrustation on massive chromite. Most of the green coatings on the chromite of the State consist of small uvarovite garnet crystals.

Fresno County: Found as coating on chromite near Madera.

Monterey County: Found on chromite in this county, W. P. Blake[9].

San Benito County: Found on chromite near Hollister and near Panoche.

145. BISMUTITE.

Hydrous carbonate of bismuth, $Bi_2CO_5.H_2O$.

Incrustations and earthy. Color white and dirty green. Streak greenish gray. Vitreous to dull luster. H=4 — 4.5; G=6.9.

The carbonate of bismuth is a secondary mineral formed by the alteration of ores containing bismuth.

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Fresno County: Occurred at the Second Sierra and Lot One mines, Kings River.

Inyo County: Found at Big Pine Creek, Hanks[6]; also at Antelope Springs, Deep Spring Valley.

Los Angeles County: White earthy bismutite has been found in this county.

Mono County: Found at Oasis, Hanks[6].

San Diego County: Occurs as an alteration of bismuth at Pala, Schaller[4].

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CHAPTER VIII.

ANHYDROUS SILICATES.

Feldspars.
- Orthoclase
- Microcline
- Anorthoclase
- Albite
- Oligoclase
- Andesine
- Labradorite
- Bytownite
- Anorthite

Pyroxene Group.
- Enstatite
  - Bronzite
- Hypersthene
- Pyroxene
  - Malacolite
  - Diopside
  - Diallage
  - Omphacite
  - Augite
  - Violan
  - Hedenbergite
- Acmite
  - Aegirite
- Spodumene
  - Kunzite
  - Hiddenite
- Wollastonite
- Pectolite
- Rhodonite

Amphibole Group.
- Anthophyllite
- Amphibole
  - Tremolite
    - Asbestos
  - Actinolite
  - Smaragdite
  - Cummingtonite
  - Uralite
  - Asbeferrite
  - Edenite
  - Hornblende
  - Soretite
  - Pargasite
  - Caranthine
- Glaucophane
- Crocidolite

Not Grouped.
- Beryl
- Nosean
- Lazurite
- Garnet
- Olivine
- Iddingsite
- Willemite
- Vesuvianite
  - Californite
- Zircon
- Topaz
- Andalusite
- Sillimanite
- Cyanite
- Datolite
- Zoisite
  - Saussurite
  - Clinozoisite
- Epidote
- Allanite
- Axinite
- Prehnite
- Lotrite
- Ilvaite
- Calamine
- Lawsonite
- Tourmaline
- Dumortierite

FELDSPARS.

The name feldspar is given to a group of alumina silicates with potash, soda and lime, whose members have the general properties of hardness, cleavage, gravity and twinning similar. They include: two potash feldspars, *orthoclase* and *microcline;* a potash-soda feldspar, *anorthoclase;* a soda feldspar, *albite;* a lime feldspar, *anorthite;* and four soda-lime to lime-soda feldspars intermediate between albite and anorthite, namely *oligoclase, andesine, labradorite* and *bytownite.* The feldspars are the most abundant and most important of the rock-forming silicates, and the classification of a volcanic rock is in general based upon the prevailing feldspar The potash feldspars are characteristic of the acid volcanics, while the albite-anorthite feldspars belong to the basic volcanics, the terms "acid and basic" meaning whether high or

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low in silica percentage. The albite-anorthite feldspars are commonly called the "plagioclase feldspars," and in many petrographic descriptions this name is used, so that the particular kind of feldspar is not designated. As rock-forming minerals the feldspars are too universally distributed to give many localities.

146. ORTHOCLASE—Potash Feldspar.

Silicate of potassium and aluminium, $KAlSi_3O_8$.

Monoclinic. Crystals very common. Often as Carlsbad twins. Perfect basal and clinopinacoidal cleavage. Colorless, white, flesh-red. Vitreous luster. H=6—6.5; G=2.57.

Orthoclase is an essential constituent of the acid igneous rocks, granites, syenites, quartz-porphyries, rhyolites and trachytes, and an occasional constituent of other more basic rocks. Large crystals often form the phenocrysts of porphyritic rocks, and these crystals are often "Carlsbad twins." The color of granites is mainly due to the color of the orthoclase, red granites having orthoclase colored by ferric oxide. Granites, syenites and diorites are often intersected by "pegmatite veins" consisting of coarse crystals and massive orthoclase, with quartz and mica, and these veins vary greatly in width, and some can be quarried for the feldspar.

Adularia is a glassy, transparent variety, sometimes found in large crystals.

Sanidine is a glassy potash feldspar, common to rhyolites and trachytes.

Valencianite is a variety name given to vein orthoclase.

147. MICROCLINE—Potash Feldspar.

Silicate of potassium and aluminium, $KAlSi_3O_8$.

Triclinic. Crystals very common. Bases often show rectangular grating structure. Cleavage like orthoclase. Color white, green. H=6—6.5; G=2.54—2.57.

Microcline has the same composition as orthoclase, but differs from it in its twinning structure and crystallization. It is a constituent of granites, syenites, and granodiorites and some of the pegmatitic veins.

Amazon stone is a green variety which has not been observed in the State.

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148. ANORTHOCLASE—Potash-soda Feldspar.

Silicate of potassium, sodium and aluminium, $KAlSi_3O_8$ with $NaAlSi_3O_8$ in varying proportions.

Triclinic. Crystals observed in rock sections. Like orthoclase in its physical properties. H = 6 — 6.5; G = 2.57 — 2.60.

Anorthoclase is a constituent of granites and granodiorites of the State, but has seldom been mentioned in the petrographical descriptions.

149. ALBITE—Soda Feldspar.

Silicate of sodium and aluminium, $NaAlSi_3O_8$.

Triclinic. Crystals common and usually as repeated twins. Often massive. Cleavage perfect basal and brachypinacoidal. Colorless and white. Vitreous luster often very glassy. H = 6 — 6.5; G = 2.62 — 2.65.

The soda feldspar is a common constituent of acid granites, acid rhyolites, granodiorites and diorites and metamorphic gneisses and schists. It forms very prominent white veins in the crystalline schists of the Coast Ranges and the Sierras. Albite is frequent as pegmatitic veins in diorites and basic igneous rocks.

150. OLIGOCLASE—Soda-lime Feldspar.

Silicate of sodium, calcium and aluminium, $m NaAlSi_3O_8$ with $n CaAl_2Si_2O_8$, nearer albite in composition.

Triclinic. Crystals, usually twinned like albite. Cleavage perfect basal and brachypinacoidal. Colorless to white. H = 6 — 6.5; G = 2.65 — 2.67.

A constituent of diorites, porphyrites, andesites, etc., and to some extent in granites, syenites and granodiorites. Occasionally found in large white masses as veins in diorite and other basic rocks.

Moonstone is a soda-lime feldspar with milky chatoyancy. Much of the so-called moonstone is chalcedony.

151. ANDESINE—Soda-lime Feldspar.

Silicate of sodium, calcium and aluminium, intermediate between albite and anorthite.

Triclinic. Crystals similar to albite. H = 5 — 6; G = 2.68 — 2.60.

A constituent of diorite, gabbro, porphyrite, andesite and other basic rocks. Only observed as a microscopical constituent.

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152. LABRADORITE—Lime-soda Feldspar.

Silicate of calcium, sodium and aluminium, $CaAl_2Si_2O_8$ with $NaAlSi_3O_8$, nearer anorthite in composition.

Triclinic. Small twinned crystals in rocks; sometimes massive with twinning striations. Properties like oligoclase. H=5—6; G=2.70—2.72.

An essential constituent of most basic eruptive rocks such as diorites, gabbros, diabases, andesites and basalts. Sometimes it occurs as veins of large cleavable masses.

153. BYTOWNITE—Lime-soda Feldspar.

Silicate of calcium, sodium and aluminium, near anorthite in composition. Triclinic. Properties like oligoclase. H=5—6; G=2.72.

A common constituent of very basic rocks like gabbros, diabases and basalts, associated with labradorite and anorthite.

154. ANORTHITE—Lime Feldspar.

Silicate of calcium and aluminium, $CaAl_2Si_2O_8$.

Triclinic. Generally in small crystals as a rock constituent. Properties like oligoclase and labradorite. H=6—6.5; G=2.74—2.76.

Anorthite is the most basic of the feldspars, and is a constituent of the very basic rocks, especially gabbros, diabases and basalts.

A few of the localities where feldspars have been noticed may be cited.

Calaveras County: Large crystals of orthoclase occur at Mokelumne Hill. Albite is a common constituent of the schists of the Mother Lode. Crystals of albite from the old Stanislaus mine, Carson Hill, had the forms: (010), (001), ($\bar{1}11$), ($\bar{1}01$) ($1\bar{1}0$), ($\bar{1}30$), (021), Jackson[3]. Crystals from Angels had the forms: (010), (110), ($1\bar{1}0$), (111), ($\bar{1}\bar{1}1$), (001), Genth[2].

The mineral from Angels was analysed by Genth.

SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O	K_2O	H_2O	
68.39	19.65	0.41	0.47	10.97	tr.	0.21	100.10 per cent

Valencianite occurs five miles east of Milton in small prismatic crystals. Forms: (160), ($10\bar{1}$), (001) and (010), Rogers[5].

Contra Costa County: Albite is a common constituent of the chlorite and actinolite-schists of the county. Numerous white veins of the mineral intersect these schists. Prominent as veins in the actinolite schist near San Pablo and analysed by Blasdale[1].

SiO_2	Al_2O_3	CaO	Na_2O	H_2O at 100°	H_2O ab 100°	
67.09	20.47	0.24	10.96	0.27	0.59	99.62 per cent

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El Dorado County: Large white crystals of orthoclase occurred at the old Cosumnes copper mine near Fairplay with bornite, molybdenite, epidote and axinite. Massive red orthoclase occurs with tourmaline at Buck's Bar, Cosumnes River. Small colorless crystals of adularia have been found on the south side of Fallen Leaf Lake with forms (110), ($\bar{1}01$), (001), and (010). They are associated with pale green diopside, Rogers[5].

Inyo County: White argentiferous orthoclase occurred at the White Lime mine, Deep Spring district. Glassy adularia was found in good crystals at Rialto in the Funeral Mountains.

Kern County: White orthoclase was reported from the Long Tom mine.

Los Angeles County: White veins of labradorite occur near Lang. Labradorite is a constituent of the rocks on Mount Gleason.

Marin County: Albite veins are common in the schists of the county. Crystals from the lawsonite schist at Reed Station have the forms: (001), (010), (021), ($0\bar{2}1$), ($\bar{1}01$), ($\bar{2}01$), (150), (130), ($\bar{1}11$), ($\bar{1}\bar{1}1$), ($\bar{1}12$), ($\bar{1}31$), ($\bar{2}21$), (120), (350), (110), ($1\bar{1}0$), ($1\bar{3}0$), ($\bar{1}\bar{1}2$), ($\bar{2}\bar{2}1$), ($\bar{2}\bar{4}1$), ($\bar{3}12$), Schaller[10].

Mariposa County: Orthoclase occurs with black tourmaline and molybdenite in the granites of the Yosemite Valley.

Mono County: Orthoclase is found in pegmatitic veins in the Blind Spring district.

Monterey County: Large phenocrysts of orthoclase occur in the porphyritic rock at Pacific Grove and Cypress Point. The potash feldspar is quarried near Chualar for pottery.

Nevada County: Anorthoclase and microcline are constituents of the diorite and granodiorite, and labrodorite, bytownite and anorthite of the diorite and gabbro of Nevada City and Grass Valley, Lindgren[6].

Plumas County: Albite is a constituent of the syenite of Spanish Creek, Murgoci[1]. Oligoclase was described by Lawson[3] as a constituent of plumasite from Spanish Peak and the mineral was analyzed by J. Newfield.

SiO_2	Al_2O_3	CaO	Na_2O	H_2O	
61.36	22.97	5.38	8.08	1.72	= 99.51 per cent

San Benito County: Albite occurs in grayish and greenish, minute twinned crystals in the rock surrounding the veins of benitoite and neptunite near the headwaters of the San Benito River. Forms: (001), (010), (110), ($1\bar{1}0$), ($1\bar{2}0$), (130), ($1\bar{3}0$), ($\bar{1}01$), ($1\bar{1}1$), ($\bar{1}\bar{1}1$), ($\bar{1}\bar{1}2$), ($\bar{1}31$), ($\bar{2}21$), Louderback[2].

San Bernardino County: Veins of orthoclase occur in the mountains in the northeastern part of the county. Massive red orthoclase occurs near Manvel.

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San Diego County: Albite was mentioned as a constituent of some of the rocks of the county by Kroustchoff[1] and analysed by him.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Ign	
65.17	tr.	21.14	0.74	1.20	0.04	1.70	9.20	0.80	=99.89 per cent

Large veins of acid pegmatite consisting of albite, orthoclase and microcline intersect dark gray diorite at Pala, Mesa Grande, Rincon and Ramona, as well as northward into Riverside County, and these veins carry large crystals of gem tourmaline and associated minerals. Large crystals of the feldspars occur in these veins showing Carlsbad, Baveno and albite twinning structure. Crystals of albite at the Victor mine, Rincon, occur tabular to (010) with forms (010), (001), (110), (1$\bar{1}$0), (1$\bar{3}$0), ($\bar{1}$01), ($\bar{2}$01), ($\bar{1}$11), ($\bar{1}\bar{1}$1), Rogers[2].

Anorthite is a constituent of the orbicular gabbro at Dehesa and was analysed by Schaller, Lawson[2].

SiO_2	Al_2O_3	CaO	Na_2O	
44.39	36.55	18.55	0.83	=100.32 per cent

Santa Barbara County: Labradorite is a constituent of the teschenites at Point Sal and was analysed by Fairbanks[4].

SiO_2	Al_2O_3	CaO	Na_2O	K_2O	Ign	
52.72	30.46	11.01	3.70	0.42	1.44	= 99.75 per cent

Santa Clara County: Oligoclase is a constituent of the glaucophane rocks of this county, Murgoci[1].

Shasta County: Veins of orthoclase occur on Tom Neal Mountain.

Tulare County: White crystals of orthoclase occur at Three Rivers.

Tuolumne County: Large crystals of orthoclase are found on Sullivan Creek. Graphic granite is common at Soulsbyville.

155. ENSTATITE.

Silicate of magnesium, $MgSiO_3$.

Orthorhombic. Generally massive, lamellar. Cleavage perfect prismatic. Color greenish or brownish gray to brown. Pearly to vitreous luster. H=5.5; G=3.1 — 3.3.

Enstatite is a rock-forming mineral which is characteristic of gabbroitic rocks and rocks that have been derived from gabbros, like much of the serpentinized rocks of the Coast Range and of the Sierras. It is a rather common mineral but has seldom been mentioned.

Bronzite is a variety in which part of the magnesia is replaced by iron. It occurs in bronze-brown reticulated masses.

Alameda County: Bronzite occurs in some of the rocks of the Berkeley Hills, Hanks[6].

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Contra Costa County: Massive enstatite is found in the Diablo Range in this and other counties to the south.

Del Norte County: Specimens of enstatite have come from this county.

Kern County: Bronzite was one of the constituents of the San Emidio meteorite and was analysed by Whitfield[2].

SiO_2	FeO	MgO	CaO	
54.42	14.03	29.11	9.46	=100.02 per cent

Mariposa County: Massive bronzite occurs in the gabbroitic rock of the old Mariposa estate.

Nevada County: Enstatite is a constituent of the gabbros of Nevada City, Lindgren[6].

San Francisco County: Enstatite or bronzite occurs abundantly in the serpentine of San Francisco, Lawson[1], Palache[2], Eakle[1].

San Luis Obispo County: Found in the serpentine at San Simeon.

Tuolumne County: Light green enstatite occurs in the gabbro between Jamestown and Montezuma and also near Jacksonville.

156. HYPERSTHENE.

Silicate of iron and magnesium $(Fe,Mg)SiO_3$.

Orthorhombic. Generally massive, foliated. Cleavage perfect brachypinacoidal. Color brownish green to brown. Pearly to vitreous luster. H=5—6; G=3.4—3.5.

The dark brown hypersthene is a constituent of basic eruptive rocks, especially gabbros and andesites.

Plumas County: A constituent of the hypersthene andesite at La Porte, Turner[1].

San Diego County: One of the minerals in the orbicular gabbro at Dehesa, Lawson[4].

San Francisco County: A constituent of the dikes cutting the serpentine of San Francisco, Palache[2].

Siskiyou County: Mentioned by J. D. Dana[2] as a constituent of the hypersthene andesite of Mount Shasta.

157. PYROXENE.

Silicate of calcium and magnesium, $CaMg(SiO_3)_2$ with or without mixtures of Fe,Al,Na and K.

Monoclinic. Prismatic crystals, granular. Cleavage perfect prismatic. Color generally some shade of green, often nearly white, brown, black. Vitreous luster. H=5—6; G=3.2—3.6.

The pyroxenes are very important rock-forming minerals, the alumina variety augite being an essential constituent of most of the basic erup-

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tives and is occasionally found in syenites and granites. The light colored non-aluminous varieties are more characteristic of metamorphic limestone and schist.

Malacolite. Lime-magnesia pyroxene, $CaMg(SiO_3)_2$. A white pyroxene often found in crystalline limestone near contact with eruptives.

Diopside. Lime-magnesia pyroxene, $CaMg(SiO_3)_2$ with ferrous iron. A light to deep grass-green pyroxene, characteristic of crystalline limestone, metamorphosed eruptive and some schists.

Diallage. Lamellar or fibrous pyroxene near diopside in composition. Characteristic of gabbros.

Omphacite. A granular non-aluminous pyroxene. Characteristic of eclogites in association with garnet.

Augite. Iron-alumina pyroxene. Dark green to black and commonest of all the pyroxenes. An essential constituent of diorites, gabbros, diabases, basalts, andesites, pyroxenites and other basic eruptives. Mentioned in all petrographic descriptions of basic igneous rocks.

Violan. A variety name for a violet-colored augite.

Hedenbergite. An iron-rich pyroxene.

Contra Costa County: Diopside is common in the schists with albite near San Pablo and has been described and analysed by Blasdale[1].

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO
Fresh	51.91	3.55	1.30	2.65	16.15	22.85
Altered	49.62	2.97	2.49	2.99	19.72	19.14

	Na_2O	H_2O at 100°	H_2O ab. 100°	TiO_2	MnO	
Fresh	0.56	0.21	0.86	0.10	0.33	=100.47%
Altered	0.60	--	2.71	--	--	=100.24

El Dorado County: Diallage is a constituent of gabbro on Mount Diablo.

Inyo County: Masses of malacolite have come from the Panamint Mountains.

Lake County: Violan occurs in Big Canyon.

Los Angeles County: Large light green crystals of diopside are found near San Pedro.

Nevada County: Diallage is a constituent of the gabbro at Nevada City and Grass Valley, Lindgren[6].

Plumas County: Diallage occurs in gabbro near Grizzly Peak, Turner[1].

Riverside County: Crystals of pale green diopside occur in the limestone at Crestmore.

San Francisco County: Crystals of diallage occur in the serpentine of San Francisco, Erman[1], Lawson[2], Palache[2].

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San Mateo County: Diallage occurs in gabbro near Crystal Springs.

Santa Barbara County: Augite as a constituent of teschenite at Point Sal was analysed by Fairbanks[4].

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2OK_2O	Ign		
46.59	9.69	1.03	4.75	21.38	13.89	1.23	1.22	=99.78%	G=2.338

Santa Clara County: Diallage occurs at Los Gatos Creek. Omphacite is a constituent of eclogite in the Calaveras Valley, Murgoci[1].

Shasta County: Hedenbergite occurs associated with ilvaite at Potter's Creek, Prescott[1].

Tulare County: Specimens of white malacolite have come from this county.

Tuolumne County: Diallage occurs in the gabbro of Rawhide Ranch.

158—ACMITE—AEGYRITE.

Silicate of sodium and iron, essentially $NaFe(SiO_3)_2$.

Monoclinic. Prismatic crystals. Color brown or dark green. Vitreous luster. H=6—6.5; G=3.50—3.55.

Acmite and aegyrite are rock-forming minerals more prominent in syenites. Their occurrence in California has not been mentioned in petrographical literature.

San Benito County: A specimen of rock containing prisms of acmite has come from some locality near Hollister. Aegyrite occurs in stellate groups in the albite associated with benitoite and natrolite, at the benitoite locality near the headwaters of the San Benito River, Louderback[2].

159. SPODUMENE.

Silicate of lithium and aluminium, $LiAl(SiO_3)_2$.

Monoclinic. Crystals sometimes very large. Cleavage perfect prismatic. Color grayish white, emerald-green, lilac, amethystine. Vitreous luster. H=6.5—7; G=3.13—3.20.

Spodumene is found in large crystals and cleavage masses in pegmatitic veins where lithia is present. It is commonly associated with the lithia mica, lepidolite, and with lithia tourmaline.

Kunzite is a beautiful transparent variety, lilac or amethystine in color.

Hiddenite is an emerald green spodumene.

Riverside County: Some kunzite occurs in the San Jacinto Mountains, near Coahuila, Schaller[2].

San Diego County: The transparent lilac variety discovered in 1903 and named kunzite by Baskerville[1], and which is used as a gem,

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occurs in the pegmatite veins at Pala with the gem tourmaline, although not very abundant nor in large pieces. Most of it is in flat cleavage pieces but fair crystals have been found with the forms: (010), (100), (110), (130), (350), (320), (121),($\bar{1}$12), Schaller[2]. The mineral has been further described by Baskerville and Kunz[1] and analysed by Schaller[2] and by Davis[1].

	SiO_2	Al_2O_3	Mn_2O_3	Li_2O	Na_2O	K_2O	CaO	MgO	NiO	MnO	ZnO	Ign.	
Schaller	64.42	27.32	0.15	7.20	0.39	0.03	--	--	--	--	--	none	= 99.61
Davis	--64.05	27.30	--	6.88	0.30	0.06	0.80	none	0.06	0.11	0.44	0.15	=100.15

A few crystals of hiddenite and some masses of white spodumene have also been found at Pala, with the kunzite, Schaller[2].

Kunzite also occurs sparingly at the Victor mine, Rincon, in tabular crystals, some of them twinned as seen by the natural etch-figures. Forms: (100), (110), (010), (320), (130), (021), (111), ($\bar{1}$11), Rogers[3].

160. WOLLASTONITE.

Silicate of calcium, $CaSiO_3$.

Monoclinic. Generally in fibrous masses. Cleavage perfect orthopinacoidal. Color white, gray, rose. Vitreous luster. H=4.5—5.0; G=2.8—2.9.

Wollastonite is formed as a contact metamorphic mineral especially near the contact of eruptives with limestone. Usually found as compact fibrous masses either white or pink.

Del Norte County: White divergent masses found near Crescent City.

Lake County: White drusy wollastonite has come from Dry Creek, near Middletown.

Napa County: Massive white occurs in Hunting Creek Canyon, near Knoxville.

Nevada County: White and pink are found as contact minerals at Grass Valley.

Riverside County: Fibrous, columnar and fine granular wollastonite occurs in the crystalline limestone at Crestmore as one of the contact metamorphic minerals. An analysis of the fine granular by Eakle gave:

SiO_2	Fe_2O_3	CaO	H_2O	
51.77	2.12	44.85	1.02	= 99.76 per cent

Santa Barbara County: Divergent fibrous masses having a pale rose color have been found at Santa Ynez.

Tehama County: Found at Glenbrook Lake.

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Tuolumne County: Found on North Mokelumne River near Bear Creek and analysed by Hillebrand, Turner[4].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O
50.67	0.20	6.77	0.31	0.50	40.34	0.58	0.22	0.14

H_2O at 110°	H_2O ab. 110°	CO_2	
0.08	0.31	0.52	=100.24%

161 PECTOLITE.

Basic silicate of calcium and sodium, $HNaCa_2(SiO_3)_3$.

Monoclinic. Generally fibrous massive. Cleavage perfect orthopinacoidal. Color white. Luster silky to vitreous. H=5; G=2.68 — 2.78.

White fibrous pectolite occurs as veins and patches in altered basic dikes and flows, and in serpentinized rocks.

San Francisco County: Fibrous pectolite occurs as veins in an altered dike which intersected the serpentine at Fort Point. Described and analsyed by Eakle[1]. Forms: (001), (100), (540), (140).

SiO_2	Al_2O_3 Fe_2O_3	CaO	Na_2O	H_2O	
53.40	3.87	30.56	7.61	4.46	= 99.90 per cent

Tehama County: Large mass occurred in serpentine on Elder Creek and was analysed by Eitel, Preston[1].

SiO_2	Al_2O_3 Fe_2O_3	CaO	Na_2O	K_2O	
56.84	1.27	33.46	3.45	3.97	= 99.63 per cent

162. RHODONITE.

Silicate of manganese, $MnSiO_4$.

Triclinic. Crystals often large. Generally massive or in grains. Cleavage perfect prismatic. Color rose-red. Vitreous luster. H=5.5 — 6.5; G=3.4 — 3.68.

The manganese silicate is often present in copper and silver veins where oxide of manganese is abundant and it is usually associated with pyrolusite or psilomelane. It is generally developed as a contact mineral in veins.

Alameda County: Some rhodonite occurs at the Corral Hollow deposit.

Butte County: Found on the north fork of the Feather River with rhodochrosite.

Plumas County: Considerable manganese occurs in the Genessee, Meadow and other valleys and canyons of the county, and some good red rhodonite has come from them. Occurred with copper at the Diadem Lode, Meadow Valley, Hanks[5], Turner[4].

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Siskiyou County: Fine specimens of rhodonite occur at Sawyer's Bar.

Tulare County: Some good gem rhodonite occurs about three miles north of Lemon Cove.

Tuolumne County: Found with pyrolusite on Rose Creek, near Columbia.

163. ANTHOPHYLLITE.

Silicate of magnesium and iron, $(Mg,Fe)SiO_3$.

Orthorhombic. Commonly lamellar or fibrous. Cleavage perfect prismatic. Color brownish gray, brownish green. Vitreous luster. H=5.5—6; G=3.1—3.2.

Anthophyllite is a metamorphic mineral occurring in schists and gneisses. It is usually found in fibrous and bladed masses, and is not uncommon, but has seldom been mentioned.

Contra Costa County: Fibrous masses of anthophyllite occur in the schists near San Pablo and the mineral has been analysed by Blasdale[1].

The analysis shows the mineral to be somewhat serpentinized.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	H_2O at 100°	H_2O ab. 100°
33.66	1.36	0.34	4.80	38.70	0.48	0.98	0.24	19.79

MnO tr. =100.26 per cent

San Bernardino County: Occurs in the Slate Range, Hanks[6].

164. AMPHIBOLE.

Silicate of calcium and magnesium, $CaMg_2(SiO_3)_4$ with or without isomorphous mixtures of Fe,Al and Na.

Monoclinic crystals, columnar, fibrous, granular. Cleavage perfect prismatic. Color white, gray, green, brown, black. Vitreous luster. H=5—6; G=2.9—3.4.

The amphiboles are similar to the pyroxenes, and, like them, are very important rock-forming minerals. They occur in metamorphic and igneous rocks, and the common varieties are to be found in every county. There are numerous varieties and those found in the State will be briefly mentioned.

Tremolite. Lime-magnesia amphibole, $CaMg_2(SiO_3)_4$. Common as a metamorphic mineral in schists and crystalline limestones in white or gray long prismatic and fibrous aggregates.

Asbestos is a soft fibrous form of amphibole having the composition of tremolite or actinolite. Much of the asbestos of the State is, however, serpentine-asbestos, which is a hydrous form of magnesium silicate.

Mountain cork and *Mountain leather* are cork-like and leathery masses of tremolite.

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Actinolite. Lime-magnesia-iron amphibole, $Ca(Mg,Fe)_3Si_4O_{12}$. Very abundant in the schists of the Coast Ranges and Sierras. Generally found in reticulated long prismatic crystals, sometimes fibrous. Color is bright grass green to dark green.

Smaragdite is an emerald-green foliated variety of actinolite.

Cummingtonite is an iron-magnesia amphibole similar to anthophyllite.

Uralite is an amphibole derived by the alteration of pyroxene. The process of change from pyroxene to amphibole is called "uralitization."

Asbeferrite is a variety of tremolite.

Edenite is a light green aluminous variety of amphibole.

Hornblende. A lime-magnesia-iron-alumina amphibole similar to augite in its general composition. Hornblende is the commonest of the amphiboles and is found in large cleavage masses to fibrous. Common color is black to very dark green, sometimes brown. Hornblende is characteristic of the acid and intermediate eruptive rocks while augite is characteristic of the basic. Hornblende forms large areas of schists or amphibolites and is also a constituent of granite, syenite, diorite, rhyolite and trachyte. Less common in gabbro, diabase and basalt.

Soretite is an amphibole showing some optical differences from hornblende.

Pargasite is an amphibole between hornblende and glaucophane in composition, but is generally classed as hornblende.

Carinthine is an amphibole between hornblende and glaucophane in composition.

Amador County: Sheets of mountain leather with mountain cork have been found at the Little Grass Valley mine, Pine Grove.

Butte County: Hornblende is the most abundant constituent of a quartz-amphibole diorite on ridge between this and Plumas counties and has been analysed by Valentine, Turner[4],[5].

SiO_2	TiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O
50.08	0.76	7.97	0.16	2.69	6.71	0.49	11.31	16.31	1.22

K_2O	H_2O	P_2O_5	
0.46	1.40	tr.	99.46 per cent

Contra Costa County: Tremolite and actinolite are common in the schists north of Berkeley and near San Pablo, and have been analysed by Blasdale[1].

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O at 100°	H_2O ab. 100°	
Tremolite	56.68	1.79	1.70	2.23	19.35	15.80	--	--	0.10	2.25	=99.90%
Actinolite	55.21	3.45	--	7.49	18.97	10.50	2.45	--	--	1.75	=99.86
	55.56	2.05	--	5.97	19.45	12.13	1.94	0.30	--	2.58	=99.98

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El Dorado County: Large cleavage masses of black hornblende occur with orthoclase, bornite, molybdenite, epidote and axinite at the old Cosumnes Copper mine near Fairplay.

Inyo County: Masses of mountain cork are found in the Swansea district and in Craig's Canyon on the east slope of the Inyo Mountains.

Marin County: Actinolite is common in the lawsonite schist of Reed Station.

Mariposa County: Hornblende is a constituent of: 1, the gabbro of Beaver Creek, near Big Trees; and, 2, of a quartz-monzonite on Tioga road, southeast of Mount Hoffman, Turner[4][7]. The first has been analysed by Valentine and the second by Hillebrand.

	SiO_2	TiO_2	Al_2O_3	V_2O_3	Fe_2O_3	FeO	MnO	NiO	CaO	MgO
1.	46.08	0.77	10.56	--	2.81	8.30	0.15	--	12.64	14.40
2.	47.49	1.21	7.07	0.04	4.88	10.69	0.51	0.02	11.92	13.06

	Na_2O	K_2O	Li_2O	H_2O at 100°	H_2O ab. 100°	P_2O_5	F		
	1.62	0.34	none	0.17	1.97	0.18	none	= 99.99%	
	0.75	0.49	tr.	--	1.86	none	0.06	=100.05	O=F 0.02=100.03

Mendocino County: Actinolite occurs at Calpella.

Mono County: Long prisms of hornblende occur in the cavities of lava near Bridgeport, with forms: (001), (010), (100), (110), ($\bar{2}$01), (021), ($\bar{1}$31), Schaller[6].

Nevada County: Hornblende occurs in large crystals in the granodiorite of Nevada City and Grass Valley, Lindgren[6]. Uralite is common in the diorite of this locality.

Placer County: Large masses of asbestos are found at Wisconsin Hill and Arizona Flat.

Plumas County: Edenite is a constituent of the plumasite of Spanish Peak, Lawson[3].

San Benito County: Actinolite occurs in the veins and wall-rock in capillary bunches at the benitoite locality, Louderback[2]. Good specimens at Tres Pinos.

San Bernardino County: Cummingtonite has been found near Daggett, with calcite. Asbeferrite occurs at Halleck.

Santa Clara County: Actinolite, smaragdite, soretite, pargasite and caranthine occur in the eclogites of Oak Ridge and Calaveras Valley, Murgoci[1], J. P. Smith[1]. Specimens twelve miles east of Gilroy.

Sonoma County: Large crystals of actinolite occur in foliated talc, near Petaluma. Mentioned by W. P. Blake[9]. Smaragdite occurs in the glaucophane-gneiss near Santa Rosa, Murgoci[1].

Tuolumne County: White fibrous tremolite occurs in the marble near Columbia; asbestos near Chinese Camp and Montezuma; mountain cork at Sawmill Flat and on Table Mountain.

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165. GLAUCOPHANE—Blue Hornblende.

Silicate of sodium, aluminium, iron and magnesium, essentially $NaAl(SiO_3)_2$. $(Fe,Mg)SiO_3$.

Monoclinic. Generally fibrous massive. Cleavage perfect prismatic. Color deep blue to bluish black. Streak grayish blue. Strongly pleochroic. Vitreous luster. H = 6 — 6.5; G = 3.1.

Glaucophane is a constituent of schists and gneisses which have been formed by metamorphism of igneous rocks containing a high percentage of sodium. Extensive areas of glaucophane rocks exist in California along the Coast Range and they have been described by Becker[1], Ransome[2], Lawson[1], Palache[3], J. P. Smith[1], Murgoci[1], Hanks[6], and others.

Crossite. This name was given by Palache[3] to a mineral which differed from glaucophane in its optical orientation and with a composition between it and riebeckite.

Contra Costa County: The glaucophane from the schists near San Pablo was analysed by Blasdale[1].

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	TiO_2	MnO	
54.52	9.25	4.44	9.81	10.33	1.98	7.56	0.16	1.78	0.39	0.46	=100.68%
52.39	11.29	3.74	9.13	11.37	3.03	6.14	tr.	2.57	0.14	tr.	= 99.80

Crossite was found in a boulder on the hillside north of Berkeley and was described by Palache[3] as a new amphibole, with analysis by W. S. T. Smith.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	
55.02	4.75	10.91	9.46	tr.	9.30	2.38	7.62	0.27	undet.	=99.70%

San Benito County: A glaucophane resembling crossite occurs in the natrolite vein carrying the benitoite near the headwaters of the San Benito River, and was analysed by Blasdale, Louderback[2].

SiO_2	Al_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O at 100°	H_2O ab. 100°	
52.94	3.76	13.40	1.44	11.54	5.45	5.11	0.43	1.31	3.72	=99.10%

Santa Clara County: Murgoci[1] mentions glaucophane as a constituent of eclogite, quartzite, mica schist and greenstone in the Calaveras Valley.

166. CROCIDOLITE.

Silicate of sodium and iron, essentially $NaFe(SiO_3)_2.FeSiO_3$.

Monoclinic. Usually fibrous. Cleavage perfect prismatic. Color deep blue or green. Vitreous luster. H = 4; G = 3.2 — 3.3. Pleochroic.

A rock-forming mineral similar to the amphiboles and glaucophanes but not so common.

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Cataphorite is a soda-iron crocidolite between berkevikite and arfvedsonite in optical characters.

Lake County: Fibrous veins of blue crocidolite are said to occur in schist near Lakeport.

Plumas County: Crocidolite and cataphorite occur in the syenite of Spanish Peak, Murgoci[1].

Santa Clara County; Cataphorite is a constituent of diorite at Oak Ridge, Calaveras Valley, Murgoci[1]. Crocidolite occurs as bluish fibrous seams in metamorphic rock east of Mount Hamilton, and an analysis of it by A. K. Schellinger is given by Rogers[5].

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O (by diff.)	H_2O
50.65	0.90	19.21	21.70	0.79	0.39	4.93	1.43

167. BERYL.

Silicate of beryllium and aluminium, $Be_3Al_2Si_6O_{18}$.

Hexagonal. Prismatic crystals, sometimes very large. Color green, blue, rose, yellow. Vitreous luster. H=7.5 — 8; G=2.63 — 2.80.

Beryl is found as crystals varying greatly in size in acid pegmatite veins, generally. All the beryl known to occur in the State is limited to the series of feldspathic pegmatite veins of Riverside and San Diego counties, in which the beautiful gem tourmalines occur. Transparent aquamarine, golden, deep green and blue crystals, forming beautiful gems when cut, occur in these pegmatites.

Riverside County: Fine yellow and green beryls occur at Coahuila and rose crystals near Hemet.

San Diego County: Yellow, green and blue crystals occur in the Palomar Mountains, nine miles southeast of Pala: Some rose, yellow and green occur at Pala and Mesa Grande. Green crystals from Rincon have the forms: $(10\bar{1}0)$, (0001), $(10\bar{1}1)$, $(11\bar{2}0)$, $(11\bar{2}1)$, $(21\bar{3}0)$, $(11\bar{2}2)$, $(13.1.\bar{1}4.1)$ and rose crystals the forms: $(10\bar{1}0)$, $(11\bar{2}1)$, $(10\bar{1}1)$, (0001), $(21\bar{3}1)$, Eakle[6]. Mentioned by Kunz[7], Schaller[4], and Rogers[2].

Tuolumne County: W. P. Blake[1] reported beryl from near Jamestown.

168. NOSEAN—Noselite.

Silicate of sodium and aluminium with sodium sulphate, $Na_4(NaSO_4.Al)Al_2(SiO_4)_3$.

Isometric. Granular. Color gray, blue, brown. H=5.5; G=2.25 — 2.4.

A rare rock-forming mineral characteristic of nepheline rocks which are unknown in the State.

San Bernardino County: There is a specimen of nosean rock from Calico exhibited in the museum of the State Mining Bureau.

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169. LAZURITE—Lapis-Lazuli.

Silicate of sodium and aluminium with sodium sulphide, $Na_4(NaS_3.Al)Al_2(SiO_4)_3$.

Isometric. Massive. Color deep azure-blue or violet-blue. Vitreous luster. H = 5 — 5.5; G = 2.38 — 2.45.

The blue ornamental mineral lapis-lazuli is rare, and is only definitely known to occur in one locality. A blue lazulite and a blue dumortierite have been erroneously reported as lazurite.

Los Angeles County: Small boulders of limestone containing lapis-lazuli with pyrite occur in the bed of San Antonio Creek, near Uplands. The boulders come from an old prospect which was thought to be a silver deposit.

Madera County: Specimens are said to have been found in the Minaret Mountains.

San Bernardino County: A small boulder of gray limestone containing lapis-lazuli, pyrite, diopside and an unknown mineral was reported as coming from this county by Rogers[5]. It is possibly a stray boulder from the Los Angeles deposit.

170. GARNET.

Silicate of Ca,Mg,Al,Fe,Cr,Mn, etc., forming several varieties.

Isometric. Rhombic dodecahedrons and trapezohedrons very common. Also compact to granular massive. Color generally some shade of red; often yellow, brown, green, black and white. Vitreous luster. H = 6.5 — 7.5; G = 3.15 — 4.3.

Garnet is one of the very common minerals of the State and probably all of the known varieties occur. It is generally a product of metamorphism and is common in metamorphic rocks such as gneiss, schist, quartzite and crystalline limestone. As a contact mineral formed by the intrusion of igneous rock into limestone and other rock it is often found in fine large crystals. Common constituent of beach sands and of the concentrates of mining districts. There are several varieties based on composition.

Grossularite, essonite, hyacinth, cinnamon stone. Lime-alumina garnet, $CaAl_2Si_3O_{12}$. Common as a contact mineral in crystalline limestone. Generally a light shade of red or green, sometimes almost white, and when clear forms a valued gem.

Pyrope. Magnesia-alumina garnet, $Mg_3Al_2Si_3O_{12}$. Occurs usually in serpentine and peridotite. Deep blood-red color.

Almandite. Iron-alumina garnet, $Fe_3Al_2Si_3O_{12}$. Common garnet of gneisses and schists. Brownish red and sometimes of gem value.

Andradite. Lime-iron garnet, $Ca_3Fe_2Si_3O_{12}$. Common garnet of gneisses and schists. Rarely clear enough for gems.

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Topazolite. Lime-iron garnet, $Ca_3Fe_2Si_3O_{12}$. Occurs usually in crystalline limestone and schist. Yellow garnet.

Spessartite. Manganese-alumina garnet, $Mn_3Al_2Si_3O_{12}$. Occurs usually in pegmatite veins. Light rose shade.

Uvarovite. Chrome garnet, $Ca_3Cr_2Si_3O_{12}$. Generally found as crystals coating massive chromite. Color emerald-green.

Trautwinite, which was described as a new mineral by Goldsmith[1], appears to be a mixture of uvarovite and chromite.

Alpine County: The old Rogers copper claim in Hope Valley was located in garnet rock. W. P. Blake[9] reported fine green grossularite from this valley.

Butte County: Red and brown garnet was common in the sands of the gold washings at Cherokee, Silliman[7].

Calaveras County: Found at Bald Point on Mokelumne River; in the gravels at San Andreas.

Del Norte County: Common in the sands at Crescent City, Gilbert Creek, Smith River.

El Dorado County: Large crystals of grossularite have been found at the old Cosumnes copper mine. Good crystals nine miles southeast of Placerville. Massive at Pilot Hill, W. P. Blake[9]. Common near Georgetown.

Fresno County: Occurs at Fresno Flat, Grub Gulch and Fort Miller.

Humboldt County: Common in the sands at Gold Bluff and Orleans.

Inyo County: Crystals and massive garnet are found in the Coso and Inyo mountains. Fine large crystals of grossularite occurred associated with white massive datolite and greenish brown vesuvianite at the San Carlos mine and the mineral was analysed by J. L. Smith[1].

SiO_2	Al_2O_3	Fe_2O_3	MnO_2	CaO	MgO		
42.01	17.76	5.06	0.20	35.01	0.13	=100.17%	G=3.59

Kern County: Massive near Hot Springs between Havilah and Kernville and on summit between Walker's Basin and Havilah.

Lassen County: Common at the Diamond mine.

Los Angeles County: In sands at Mount Meadows.

Marin County: Andradite crystals are common in the schist of the Tiburon Peninsular.

Mariposa County: Massive brown almandite occurs on Mount Hoffman. Good crystals are found at the junction of Moore Creek and Mokelumne River.

Mendocino County: Common in the sands at Fort Bragg.

Monterey County: Common in the sands of the Los Burros district. Uvarovite has been found coating chromite in the county. Trautwinite,

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which was described as a new mineral by Goldsmith[1], from this county, appears from the analysis to be a mixture of uvarovite and chromite.

SiO_2	Cr_2O_3	Fe_2O_3	Al_2O_3	CaO	MgO	Ign.		
21.78	38.39	13.29	0.81	18.58	7.88	0.11	=100.84%	G=3.505

Nevada County: In the concentrates of the Rough and Ready district. With wollastonite at Grass Valley, Lindgren[6].

Orange County: A constituent of the schists near Anaheim. Pale apple-green pebbles of grossularite were found near El Toro and analysed by Steiger, Clarke[3].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Alk	P_2O_5	Ign.		
37.54	tr.	22.84	0.79	0.26	36.66	0.44	0.13	tr.	1.74	=100.40%	G=3.485

Placer County: Essonite is found at Deer Park, and on the American River near Towle. Uvarovite has been found on chromite near Auburn.

Plumas County: In sands at Nelson Point and at the Good Hope mine.

Riverside County: One of the minerals in the concentrates at Holcomb. Occurs massive at the Santa Ana tin district. Hyacinth or essonite is found at Hemet. Abundance of grossularite and some andradite garnet occurs in the crystalline limestone at Crestmore, associated with vesuvianite, diopside and wilkeite. An analysis of the grossularite by J. Buford Wright gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CuO	CaO	MgO	Na_2O	H_2O		
35.52	21.11	3.95	0.60	0.70	36.06	0.78	0.20	1.23	=100.15%	G=3.39

San Benito County: Fine green crystals were found coating chromite and rhodochrome at New Idria, Brush[1].

San Diego County: Fine crystals of transparent essonite garnet are found in the tourmaline districts of Mesa Grande, Pala and Rincon and these have been extensively cut into gems under the name "hyacinth." Essonite also occurs about ten miles east of Jacumbe Hot Springs with vesuvianite and quartz. Garnet is found in the Julian district and at Ballina. Spessartite was reported from Mesa Grande but it may have been essonite. Fine granular red at Rincon, Rogers[2].

Santa Barbara County: Common in the sands at Point Sal.

Santa Clara County: A constituent of the eclogites of Calaveras Valley, Murgoci[1]. Analysed from the omphacite-eclogite of Coyote Creek by W. O. Clarke, J. P. Smith[1].

SiO_2	Al_2O_3	FeO	MgO	CaO	
38.69	19.10	26.81	5.07	10.64	=100.38%

Shasta County: Uvarovite has been found on chromite on Shotgun Creek. Red garnet on Round Mountain. Bands of garnet mixed with pyroxene occur on McCloud River on contact between diabase and carboniferous limestone.

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Siskiyou County: In sands at Cecilville and on Klamath River.

Sonoma County: Large masses of garnet occur near Petaluma, W. P. Blake[9].

Trinity County: Uvarovite has been found at Carrville.

Tulare County: White massive grossularite was found in the northwest corner of the county, which was analysed by Steiger, Kunz[7].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	MnO	H_2O at 100°	H_2O ab. 100°
38.59	--	22.24	0.45	0.36	35.97	0.64	0.10	0.31	0.80
						CO_2	F		
						0.39	0.17	=100.02%	

Essonite in good crystals occurs at Three Rivers. Topazolite was found at the Old Soldier mine, Drum Valley, twelve miles northeast of Visalia. Aplome, a manganese andradite, was found near Visalia.

Tuolumne County: With epidote at Mutton ledge; in schist on Jarvis ranch and at Soulsbyville.

171. MONTICELLITE.

Silicate of calcium and magnesium, $CaMgSiO_4$.

Orthorhombic. Usually massive or in grains. Color yellowish gray or light brown. H=5 — 5.5; G=3.03 — 3.25.

A rare mineral formed by contact metamorphism in a magnesian limestone.

Riverside County: One of the many minerals occurring in the crystalline limestone at Crestmore. It was found massive and in isolated grains in the blue calcite, associated with xanthophyllite. Analysed by Eakle.

SiO_2	FeO	CaO	MgO	
37.26	3.35	34.26	24.74	= 99.61%

172. OLIVINE—Chrysolite—Peridot.

Silicate of magnesia and iron $(Mg,Fe)_2SiO_4$.

Orthorhombic. Generally in grains. Color olive-green, grayish green. Vitreous luster. H=6.5 — 7; G=3.27 — 3.37.

Olivine is a rock-forming mineral which is practically limited to very basic eruptive rocks like diabase, basalt, andesite, gabbro and peridotite. Occurs occasionally in clear green crystals large enough to cut into gems.

Butte County: A constituent of diabase at Mooreville Ridge, Turner[1]. Also in the concentrates at Oroville and Cherokee.

Del Norte County: In the sands at Crescent City, Gilbert Creek and Smith River.

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Humboldt County: In the beach sands at Gold Bluff and also in the sands at Orleans Bar and Trinidad.

Los Angeles County: Small amount is found in the sand at Ocean Park.

Mendocino County: Occurs in the sand at Fort Bragg.

Nevada County: In the gabbro-serpentine series at Grass Valley, Lindgren[6].

Plumas County: A constituent of plumasite at Spanish Peak, Lawson[3].

San Diego County: A constituent of the gabbro at Dehesa, Lawson[4].

San Francisco County: In the serpentine of San Francisco, Lawson[2], Palache[2].

San Mateo County: In the beach sands of the county.

Santa Cruz County: Small amount of the crystals in the sands at Aptos.

Siskiyou County: At the forks of the Salmon in sand.

Yuba County: Quite a prominent constituent of the concentrated sands at Marysville.

173. IDDINGSITE.

Silicate of iron, magnesium, calcium and sodium.

Orthorhombic. Lamellar crystals. Cleavage perfect macropinacoidal. Color chestnut-brown to yellowish green. Bronze luster. H=2.5; G=2.84.

Iddingsite is the name given by Lawson[1] to a new rock-forming mineral similar to olivine, found in basic eruptive rocks. Since its discovery the mineral has been observed in many other localities in the rock sections.

Monterey County: The mineral was first observed in reddish sections in the carmeloite (augite-andesite) at Carmelo Bay.

174. WILLEMITE.

Silicate of zinc, Zn_2SiO_4.

Hexagonal, rhombohedral. Crystals usually prismatic. Also massive and granular. Cleavage basal. Color light green, apple-green, flesh red. Vitreous luster. H=5.5; G=3.89 — 4.18.

Very little zinc has been found in the State except in the form of the sulphide and carbonate. Willemite is sometimes found with the more common calamine as a dehydrated product.

Inyo County: Found with calamine and hydrozincite at the Ygnacio and Cerro Gordo mines.

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175. WERNERITE—Scapolite.

Tetragonal. Usually massive granular. Color white, gray or pink. H = 5 — 6; G = 2.66 — 2.73.

Scapolite is the name given to a group of rock-forming silicates consisting of isomorphous mixtures of $Ca_4Al_6Si_6O_{25}$ with $Na_4Al_3Si_9O_{24}Cl$. Wernerite is the most common member of the group. The scapolites are in general formed by contact metamorphism.

Nevada County: Scapolite occurs in a contact schist at Nevada City and Grass Valley, Lindgren[6].

176. VESUVIANITE—Idocrase.

Basic silicate of calcium and aluminium, $H_4Ca_{12}(Al,Fe)_6Si_{10}O_{42}$.

Tetragonal. Square prisms, granular, massive. Color brown to green. Vitreous luster. H = 6 — 6.5; G = 3.35 — 3.45.

Vesuvianite is a characteristic mineral formed in limestone near the contact with intrusive rocks. It is often associated with grossularite garnet.

Californite. A very compact massive green vesuvianite, resembling jade, named by Kunz[4]. Occurs as streaks and nodules in serpentine.

Butte County: Good green californite occurs on the west side of the North Fork of Feather River, near Big Bar. It occurs as streaks and nodules in serpentine. Rogers[5] mentions some water-worn pebbles from the Feather River.

El Dorado County: Brown crystals of vesuvianite occurred at the Siegel Lode, W. P. Blake[9].

Fresno County: Californite occurs on east side of Watts Valley, about thirty-two miles east of Fresno.

Inyo County: Brownish green crystals were associated with garnet and massive white datolite at the San Carlos mine. Analysed by J. L. Smith[1].

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	K_2O	Ign.	
36.56	17.04	5.93	0.18	35.94	1.07	0.51	2.00	=99.23%

Riverside County: Green and brown vesuvianite masses and crystals are common in the crystalline limestone at Crestmore. Analysed by J. Buford Wright: G = 3.36.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CuO	CaO	MgO	Na_2O	H_2O
36.88	17.61	3.11	0.46	1.50	1.06	33.27	4.73	0.34	0.61=99.57%

San Diego County: Brown vesuvianite occurs with essonite garnet about ten miles east of Jacumba Hot Springs, Kunz[7].

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Siskiyou County: The apple-green variety, *californite*, outcrops for about 200 feet along the south fork of Indian Creek, twelve miles from Happy Camp, and the mineral was analysed by Steiger, Kunz[4].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O at 100°	H_2O ab. 100°
35.86	0.10	18.35	1.67	0.39	0.05	33.51	5.43	0.29	4.18

P_2O_5	CO_2	F	
0.02	--	--	=99.85%

This is the original locality of the variety.

Tulare County: Californite is found in the chrysoprase locality east of Porterville. This variety occurs also with white grossularite garnet in the northwest corner of the county, about thirty-five miles east of Selma. Analysed by Steiger, Kunz[7].

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	H_2O at 100°	H_2O ab. 100°	CO_2
36.55	18.89	0.74	0.74	35.97	2.33	0.58	3.42	0.91

F	
0.13	=100.26%

177. ZIRCON.

Silicate of zirconium, $ZrSiO_4$.

Tetragonal. Small prisms. Colorless, pink, grayish brown. Vitreous luster. H=7.5; G=4.68—4.7.

Zircon is an almost constant accessory mineral in the acid eruptive rocks, especially granites and syenites. The concentrates from the gold washings and the black sands generally carry some zircon crystals, but there is no locality in the State known for "zircon sands."

Alameda County: Mentioned as one of the constituents of the soda-rhyolite of North Berkeley, Palache[2].

Butte County: First mentioned in the State by Silliman[7] as a constituent of the gold-washings at Cherokee. Has been observed in the sands at Oroville, Sterling City, Little Rock Creek and Brush Creek.

Calaveras County: In the sands at Douglas Flat and Wallace.

Del Norte County: At Crescent City, Gilbert Creek and Smith River.

El Dorado County: Sands of the Brownsville district, near Placerville and at Grizzly Flat.

Fresno County: In the sands at Picayune Flat.

Humboldt County: The beach sands at Gold Bluff and Upper Gold Bluff contain a little zircon. Also found at Orleans and Trinidad.

Marin County: In quartzite near Reed Station, Murgoci[1].

Mendocino County: Observed at Fort Bragg, in Anderson Valley, and on the Navarro River.

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Nevada County: A constituent of the granodiorite of Nevada City, Lindgren[6]. Also in the concentrates at Nevada City, Grass Valley and Rough and Ready.

Placer County: Observed at Butcher Ranch and Gold Run.

Plumas County: In the Diadem Lode, Meadow Valley, Turner[4]. In the sands at Spanish Ranch and Rock Island Hill.

Riverside County: Small amounts in the sands at Holcombe.

Sacramento County: Common in the sands at Michigan Bar.

San Diego County: A constituent of the dumortierite schist at Dehesa, Schaller[5].

San Luis Obispo County: The beach sands at Port Harford and Pismo contain some zircon.

San Mateo County: The beach sands of the county show a little of the mineral.

Santa Barbara County: In the sands at Point Sal.

Santa Cruz County: At Aptos.

Shasta County: In the sands from French Gulch and Redding.

Siskiyou County: In the sands of Jackson Creek, Scott River, Salmon River and at Sawyer's Bar. Colorless and pale pink crystals from near Fort Jones have the forms: (100), (110), (101), (111), (311), (511), Eakle[1].

Trinity County: At Trinity Center, Burnt Ranch, Junction City, Minersville and in the sands of the streams.

Yuba County: In the sands of Camptonville.

178. TOPAZ.

Silicate of aluminium and fluorine, $Al(O,F_2)AlSiO_4$.

Orthorhombic. Prismatic crystals. Cleavage perfect basal. Colorless, aquamarine, yellow, blue. Vitreous luster. H = 8; G = 3.4 — 3.65.

Topaz occurs in veins in metamorphic and eruptive rock where fluorine has accompanied the formation of the vein. It is usually associated with tourmaline and other minerals whose formation has been due to the action of gases on the constituents of the rock.

Butte County: Mentioned by Silliman[7] as a constituent of the sands at Cherokee. Probably mistaken for zircon.

San Diego County: Fine large crystals of colorless and aquamarine topaz occurred at the Little Three and Sunrise mines, a few miles from Ramona. Some of them resemble the topaz from the Urals.

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179. ANDALUSITE—Macle—Chiastolite.

Silicate of aluminium, Al_2SiO_5.

Orthorhombic. Prisms. Color gray, pink, rose-red. Vitreous luster. H = 7.5; G = 3.16 — 3.20.

Occurs as a constituent of gneisses and schists, and is usually associated with cyanite, sillimanite and staurolite.

Chiastolite is a variety found in carbonaceous schists, in knotty and long prismatic individuals having black inclusions of carbon arranged axially, and thus forming black crosses seen in the transverse sections.

Mariposa County: Chiastolite schists are abundant along the Chowchilla River and were first reported by W. P. Blake[1]. This variety was mentioned by Turner[1] from the Ne Plus Ultra mine, near Barenda, from the Daulton ranch near Indian Gulch and from Yaqui Gulch near Mariposa.

Nevada County: Andalusite is a constituent of quartzite at Grass Valley, Lindgren[6].

Riverside County: Large crystals of pink andalusite are found near Coahuila, Kunz[7], Schaller[4].

180. SILLIMANITE—Fibrolite.

Silicate of aluminium, Al_2SiO_5.

Orthorhombic. Long slender prisms and fibers. Cleavage perfect brachypinacoidal. Color grayish and light brown. Vitreous luster. H = 6 — 7; G = 3.23.

A constituent of metamorphic gneiss and schist, and usually with cyanite, andalusite and staurolite.

Mariposa County: Occurs in the schists near Mariposa, Turner[4], Fairbanks[1].

San Diego County: A constituent of the dumortierite gneiss at Dehesa, Schaller[5].

181. CYANITE—Disthene.

Silicate of aluminium, Al_2SiO_5.

Triclinic. Long slender or blade-like crystals. Cleavage perfect macropinacoidal. Color sky-blue, green, white. Vitreous to pearly luster. H = 5 — 7; G = 3.56 — 3.67.

A common metamorphic mineral found in schists and gneisses with andalusite, sillimanite and dumortierite.

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Imperial County: Large blue boulders of dumortierite rock found in the Cargo Muchacho district near Ogilby contain small crystals of cyanite.

Los Angeles County: Found in the schists near Los Angeles.

Tuolumne County: A constituent of the schists on Yankee Hill.

182. DATOLITE.

Basic silicate of boron and calcium, $HCaBSiO_5$.

Monoclinic. Small crystals and massive. Colorless to white, often with greenish tinge. Vitreous luster. H=5—5.5; G=2.9—3.0.

Datolite forms veins of glassy crystals or white massive material in dikes and along the contact of igneous intrusions of diabase and diorite.

Inyo County: White massive datolite was associated with vesuvianite and garnet at the San Carlos mine and was analysed by J. L. Smith[1].

SiO_2	B_2O_3	CaO	H_2O		
38.02	21.62	33.87	5.61	=99.12%	G=2.988

San Francisco County: Glassy crystals and white veins of datolite occur in an old altered diabase dike in the serpentine at Fort Point. Analysed by Schaller. Forms: (001), (100), (110), (120), (011), (012), (102), (104), ($\bar{1}02$), (111), $\bar{1}11$), ($\bar{1}12$), ($\bar{1}13$), ($\bar{1}14$), ($\bar{1}16$), (312), (121), ($\bar{2}31$), (1.1.18), Eakle[1].

SiO_2	Al_2O_3	B_2O_3	CaO	H_2O	
36.71	0.17	22.11	33.83	6.52	=99.34%

183. ZOISITE.

Basic silicate of calcium and aluminium, $HCa_2Al_3Si_3O_{13}$.

Orthorhombic. Prismatic crystals; sometimes massive. Cleavage perfect brachypinacoidal. Color grayish white to greenish gray. Vitreous luster. H=6—6.5; G=3.25—3.37.

Zoisite belongs to the metamorphic class of minerals and is often developed by the metamorphism of gabbros and diorites. It is not an uncommon mineral in the State, but has seldom been mentioned.

Saussurite is a mixture of zoisite and plagioclase feldspar formed in gabbros and plutonic rocks by alteration and pressure, and the process of change is called "saussuritization."

Clinozoisite. Name given to a rock-forming silicate near zoisite in composition but monoclinic in crystallization.

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Lake County: Mentioned by Becker[1] as common in the metamorphic rocks at Sulphur Bank and in the Coast Range. Analysed from Sulphur Bank.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	NiO	MnO	CaO	MgO	Na_2O
39.80	tr.	22.72	4.85	1.49	--	0.26	17.55	3.89	4.09
39.19	1.17	22.76	6.49	1.78	tr.	0.09	22.02	1.64	3.38

K_2O	H_2O	P_2O_5	
0.12	5.25	--	=100.02%
0.58	1.12	tr.	=100.22

Plumas County: Found in the Diadem Lode, Meadow Valley, Turner[4].

Santa Clara County: Mentioned by Murgoci[1] in the eclogite of Oak Ridge. Clinozoisite also occurs as a constituent of the eclogites of the Calaveras Valley.

Shasta County: Saussurite was analysed by Clarke[1] from a gabbro found thirty-seven miles north of Pit River Ferry.

SiO_2	Al_2O_3	FeO	CaO	MgO	Na_2O	H_2O	
42.79	29.43	3.65	18.13	1.40	2.51	2.42	=100.33%

Sonoma County: Found in quartzite at Pine Flat, Murgoci[1].

184. EPIDOTE.

Basic silicate of calcium, aluminium and iron, $HCa_2(Al,Fe)_3Si_3O_{13}$.

Monoclinic. Crystals, massive, earthy. Cleavage perfect basal. Color pistachio-green, dark green, dark brown, yellow. Vitreous luster. H=6 — 7; G=3.25 — 3.5.

Epidote is a very common mineral in the State, especially as an alteration mineral in crystalline rocks. It is often found in aggregates of large crystals and columnar masses in veins with quartz and feldspar.

Butte County: Mentioned by Silliman[7] as a constituent of the gold washings at Cherokee.

Calaveras County: Large crystals found at Bald Point on the Mokelumne River, at Mokelumne Hill, and at Copperopolis.

Contra Costa County: In the rocks on Mount Diablo and in the Diablo Range.

El Dorado County: Fine large crystals occurred in a coarse vein with orthoclase, bornite and molybdenite which were coated with axinite, at the old Cosumnes copper mine. Minute prisms in quartz at Placerville.

Inyo County: Columnar specimens have come from near Independence.

Los Angeles County: Found with bitumen and orthoclase at White Point and with labradorite near San Pedro.

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Madera County: Common on the Minaret Mountains.

Marin County: Occurs with lawsonite at Reed Station, Ransome[2].

Mariposa County: Massive at Hornitos. Also near Coulterville and at Yosemite Cliff. On the south side of Mount Hoffman.

Nevada County: Common near Glen Alpine with violet axinite. At Meadow Lake, Lindgren [4],[5].

Placer County: Near Newcastle.

Plumas County: With garnet and quartz on Mount Herbert.

San Bernardino County: Common in the Monte Negros district, Storms[1].

San Diego County: Occurs as a secondary mineral with black tourmaline at Rincon, Rogers[3].

Santa Clara County: In the eclogite of Calaveras Valley, Murgoci[1].

Shasta County: Epidote from this county was analysed by Schaller.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O
38.22	25.12	8.75	1.25	0.19	tr.	22.77	0.11	0.06

H_2O at 105°	H_2O ab. 105°	TiO_2

Tulare County: Common in the Mineral King district, Goodyear[1]. Large divergent columns at Eber Flat and at Three Rivers. Also common in Fraser Valley.

Tuolumne County: Near Sonora.

Yuba County: At Smartsville.

185. ALLANITE—Orthite.

Basic silicate of calcium, iron, aluminium and cerium.

Monoclinic. Flat tabular crystals and imbedded grains. Color brownish black. Pitchy luster. H=5.5 — 6; G=3.5 — 4.2.

A constituent of some crystalline rocks, but its reported occurrence in the State is doubtful.

Santa Barbara County: Said to have been found in rock near Santa Barbara.

186. PIEDMONTITE.

Basic silicate of calcium, aluminium, manganese and iron, $HCa_2(Al,Mn,Fe)_3Si_3O_{13}$.

Monoclinic. Prismatic crystals. Color reddish brown and reddish black. Reddish streak. Vitreous luster. H=6.5; G=3.4.

San Diego County: Found in the thin section of a dark red quartz-porphyry boulder from the gravels at Pacific Beach, Rogers[5].

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187. AXINITE.

Borosilicate of aluminium and calcium with iron and manganese, $H(Ca,Mn,Fe)_3BAl_2(SiO_4)_4$.

Triclinic. Thin wedge-shaped crystals. Sometimes granular massive. Color clove-brown, yellow. Vitreous luster. H=6.5—7; G=3.27

Crystals of axinite are sometimes developed in the veins and along the contact of intrusive rocks but the mineral is rather rare in its occurrence.

El Dorado County: Small clove-brown crystals occurred embedded on epidote at the old Cosumnes copper mine near Fairplay. They have been described and analysed by Schaller[11]. Forms: $(1\bar{1}0)$, (010), $(1\bar{2}0)$, $(1\bar{3}0)$, $(1\bar{6}0)$, (1.29.0), (160), (270), (7.11.0), (110), (540), (430), (210), (310), (510), (100), $(3\bar{1}0)$, $(9\bar{5}0)$.

SiO_2	Al_2O_3	FeO	CaO	MnO	MgO	B_2O_3	H_2O	
42.79	16.38	4.22	19.21	8.76	0.09	6.70	1.85	=100.00%

Inyo County: Found in the Funeral Mountains and in the Owl Mountains, Death Valley.

Nevada County: Thin bladed masses of violet-colored axinite occur in veins near Glen Alpine.

Riverside County: A large axinite crystal from the city quarry at Riverside, measured 9 by 12 by 1½ centimeters. The forms are: $(1\bar{1}1)$, (111), $(1\bar{1}0)$, (201), (001), (110), and $(0\bar{1}0)$. The axinite of this quarry is violet-brown, Rogers[5].

San Diego County: Smoky-pink crystals occur in an altered granite in Moosa Canyon, about eighteen miles south of Pala near Bonsall, associated with quartz, epidote and laumontite, and have been described by Schaller[11]. Forms: $(1\bar{1}0)$, $(1\bar{3}0)$, (110), (100), $(3\bar{3}1)$, $(1\bar{1}1)$, $(1\bar{1}2)$, (021), $(\bar{1}32)$, (201), (111), $(1\bar{3}1)$, $(1\bar{3}2)$.

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MnO	MgO	B_2O_3	H_2O	
42.61	17.43	0.38	7.53	19.74	4.10	0.44	6.04	1.56	=99.83%

188. PREHNITE.

Acid silicate of calcium and aluminum, $H_2Ca_2Al_2Si_3O_{12}$.

Orthorhombic. Tabular crystals, granular, drusy masses. Color light green to white. Vitreous luster. H=6—6.5; G=2.8—2.95.

Green drusy coatings and veins of prehnite are sometimes present in altered diabase and lavas, but the mineral is not common in the State.

Lotrite is a mineral similar to prehnite in composition, but differs from it in optical characters.

San Diego County: Prehnite was analysed by Schaller, from Smith Mountain, near Oak Grove.

SiO_2	Al_2O_3	Fe_2O_3	CaO	H_2O under 300°	Ign.		
43.48	24.52	0.34	27.19	4.32	0.17	=100.02%	G=2.815—2.909
42.63	26.64	--	27.05	4.26		=100.58	

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Santa Barbara County: Prehnite occurred in the analcite-diabase of Cuyamas Valley, Fairbanks[3].

Santa Clara County: Lotrite was observed by Murgoci[1] as probably present in the greenstone of Calaveras Valley.

189. ILVAITE.

Silicate of iron and calcium, $CaFe_2(FeOH)(SiO_4)_2$.

Orthorhombic. Long prisms vertically striated. Color grayish black. Submetallic luster. H=5.5—6; G=4.0.

Ilvaite is a rare mineral and is only known from one locality in the State. Formed by contact metamorphism in crystalline limestone.

Shasta County: Thin bands and long prisms of ilvaite occur on both sides of a narrow dike cutting through limestone on Potter Creek, near Baird. The crystals occur on quartz and hedenbergite and have been described by Prescott[1]. Forms: (110), (120), (010), (111), (101), (890). Analysed by H. R. Moss.

SiO_2	Fe_2O_3	Al_2O_3	Cr_2O_3	FeO	MnO	CaO	MgO	H_2O	
28.09	20.80	0.32	0.13	29.93	3.24	15.89	0.18	1.62	=100.20%

190. CALAMINE.

Basic silicate of zinc, $H_2Zn_2SiO_5$.

Orthorhombic. Hemimorphic crystals, drusy masses, earthy. Cleavage perfect prismatic. Color white; sometimes bluish or brown. H=4.5—5; G=3.4—3.5.

Calamine is found in the oxidized portion of veins carrying zinc, but its occurrence in California is quite limited.

Inyo County: Small amounts have been found with willemite and smithsonite at the St. Ygnacio, Cerro Gordo and Indiana mines, and in Surprise Canyon.

San Bernardino County: Found with smithsonite at the Cuticura mine, near Daggett.

191. LAWSONITE.

Basic silicate of calcium and aluminium, $H_4CaAl_2Si_2O_{10}$.

Orthorhombic. Prismatic and tabular crystals. Cleavage perfect basal and brachypinacoidal. Color pale blue to white. Vitreous luster. H=8; G=3.09.

Lawsonite was discovered in California as a new constituent of certain schists, and since its discovery has been found to be quite widespread in its occurrence in the rocks of the Coast Range. It is limited to the metamorphic rocks.

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Marin County: Discovered as a new mineral in the schists of the Tiburon Peninsular, near Reed Station, and was described and named by Ransome[2]. Forms: (011), (110), (041), (001). Additional forms by Hillebrand and Schaller[1], (221), (331).

Analyses: 1. Ransome and Palache; 2. Hillebrand and Schaller.

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O
	38.10	--	28.88	0.85	--	--	18.26	0.23	--	0.65
	37.32	--	35.14		--	--	17.83	--	--	--
2.	38.45	0.38	31.35	0.86	0.10	tr.	17.52	0.17	0.23	0.06

Ign.	
11.42	= 99.39%
11.21	=101.50
11.21	=100.33

Contra Costa County: Found as a constituent of a chlorite boulder on side of hill north of Berkeley and analysed by Eakle[6].

SiO_2	$Al_2O_3Fe_2O_3$	CaO	H_2O	
38.43	33.39	16.85	9.83	=98.50%

San Luis Obispo County: Masses of green chlorite with platy crystals of lawsonite occur about four miles east of San Luis Obispo.

Santa Clara County: Mentioned by Murgoci[1] and by J. P. Smith[1] as one of the constituents of the gneisses, schists and quartzites of Oak Ridge, Redwood and Calaveras Valley.

192. TOURMALINE.

Borosilicate of aluminium with various bases.

Hexagonal, rhombohedral. Long prismatic crystals, often divergent radiating groups. Color black, green, rose-red, brown, blue, smoky. Vitreous luster. H = 7 — 7.5; G = 2.98 — 3.2.

Black tourmaline is a very common mineral in the State and large areas of tourmaline-granites exist in the Sierras. Brown tourmaline has also been found, but in limited quantity. The richly colored red and green tourmalines of San Diego County are the finest in the world, and have become almost universally known and used as gems. Tourmaline always occurs in prismatic crystals, often bunched into radiating groups and usually much fractured. The common black tourmaline is characteristic of granites and quartz veins in granites. Brown tourmaline is found in crystalline limestone near the contact with intrusive igneous rock. The transparent green and red and other shades occur in pegmatite veins which carry lithia and they are classed as lithia-tourmalines. The red tourmaline is often called *rubellite,* the blue, *indicolite* and the colorless, *achroite.*

Alpine County: Black tourmaline is common in Hope Valley.

El Dorado County: Black tourmaline occurs with orthoclase at Buck's Bar.

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Fresno County: Black is common in Fine Gold Gulch, at the Enterprise mine, and at Eber Flat.

Inyo County: Black occurs in the Lee district.

Kern County: Black is found in the rocks of the Tehachapi Mountains.

Mariposa County: Black is very common in the granites of the Yosemite Valley.

Nevada County: Black occurs at Emerald Bay, Lake Tahoe and near Crystal Peak. A dark brown variety found two miles northwest of Colfax was analysed by Melville[2].

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	B_2O_3	Ign.
36.40	33.64	3.13	1.51	10.01	0.12	2.49	6.52	3.53

F 0.74 = 98.07 − O=F 0.31 = 97.76%

Orange County: Black is found at the Santa Ana tin mine, Santa Ana Mountains.

Placer County: Black at Soda Springs.

Riverside County: Some fine gem tourmaline occurs near Coahuila and in the San Jacinto Mountains.

San Bernardino County: Black at Halleck.

San Diego County: A series of pegmatite veins consisting mainly of white albite with quartz and lepidolite mica, cut through the diorite hills in the northwestern part of the county from the vicinity of Mesa Grande northward through Pala and into Riverside County, and these veins have been prolific in their yield of beautiful transparent tourmalines in many shades of rose-red and green. The first mention of the occurrence of rubellite and lepidolite in southern California was by W. P. Blake[15], who gave the locality as the San Bernardino Range. Later Orcutt[1] described the occurrence at Pala. The first material obtained was the lavender and lilac lepidolite containing radiating clusters of bright red rubellite prisms, which form beautiful museum specimens and can be seen in most mineral collections. The gem varieties were found later and since 1893 a number of mines have been located and many large beautiful crystals obtained. At present the best tourmalines come from Mesa Grande. Sterrett[1] gives the crystallography of tourmaline from Damoron ranch, four miles northwest of Mesa Grande. Forms: $(02\bar{2}1)$, $(12\bar{3}0)$, $(14\bar{5}0)$, $(21\bar{3}1)$, $(12\bar{3}2)$, $(000\bar{1})$, $(01\bar{1}\bar{1})$, $(10\bar{1}\bar{2})$, $(11\bar{2}0)$, $(10\bar{1}0)$, $(01\bar{1}0)$, $(10\bar{1}1)$, and (0001). Tourmalines of many shades, black, pink, blue, violet, green and colorless, occur at Rincon in the Victor and other claims and some of the crystals have the forms: $(11\bar{2}0)$, $(10\bar{1}0)$, $(01\bar{1}0)$, $(12\bar{3}2)$, $(10\bar{1}1)$, $(000\bar{1})$, $(01\bar{1}\bar{1})$, Rogers[3]. Analyses of the tourmaline of the county have been made by Schaller[7]. 1. Pink from Mesa Grande; 2. Pale green from Mesa

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Grande; 3. Pink from Pala; 4. Altered pink from Pala; 5. Black from Lost Valley; 6. Black from Ramona.

SiO_2	37.57	36.72	36.98	37.05	35.96	35.21
Al_2O_3	42.18	41.27	43.69	44.25	33.28	36.07
TiO_2	tr.	0.06	--	--	0.36	0.23
FeO	0.19	1.13	--	--	11.04	11.11
MnO	0.24	1.48	tr.	tr.	0.13	0.98
MgO	none	none	tr.	0.10	3.48	0.19
CaO	1.20	0.87	0.25	0.22	0.42	0.25
Li_2O	1.92	1.76	1.28	1.27	none	tr.
Na_2O	2.05	2.23	2.02	1.06	2.16	1.92
K_2O	none	none	2.29	1.95	none	none
B_2O_3	10.65	10.60	7.66	2.46	10.61	10.48
H_2O	3.39	3.33	4.67	10.81	3.31	3.51
F	0.29	0.31	--	--	none	--
	99.77	99.76	98.84	99.17	100.75	99.95%

San Luis Obispo County: Black tourmaline occurs in the rocks of the Santa Margarita Hills.

Tulare County: Black in Frazer Valley, Drum Valley, and at Mineral King.

Tuolumne County: Black near Crimea House, near Sonora and near Soulsby.

193. DUMORTIERITE.

Basic silicate of aluminium with boron. $HAl_8BSi_3O_{20}$.

Orthorhombic. Small prisms, granular. Color smalt-blue, dark blue, violet-red. Vitreous luster. H=7; G=3.22 — 3.43.

Dumortierite is a metamorphic mineral found in certain gneisses and schists; very rare in its occurrence.

Imperial County: Dark blue boulders of dumortierite occur on the plains about twenty-five miles from Ogilby.

San Diego County: A violet-red variety of dumortierite occurs near Dehesa and was described and analysed by Schaller[5] and also analysed by Ford[1]. Forms: (010), (100), (110), (120), (320), (210), (102), (203).

	SiO_2	Al_2O_3	Ti_2O_3	Fe_2O_3	B_2O_3	H_2O	
Schaller	28.68	63.31	1.45	0.23	5.37	1.52	=100.56%
Ford	30.58	61.83	--	0.36	5.93	2.14	=100.84

Tuolumne County: Boulders of dark blue dumortierite have been found in the county.

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CHAPTER IX.

HYDROUS SILICATES AND TITANO-SILICATES.

Zeolites.
Gyrolite
Apophyllite
Okenite
Heulandite
Laumontite
Stilbite
Chabazite
Analcite
Natrolite
Mesolite

Micas.
Muscovite
Mariposite
Paragonite
Lepidolite
Biotite
Lepidomelane
Roscoelite

Brittle micas.
Margarite
Xanthophyllite
Chloritoid
Ottrelite

Chlorites.
Clinochlore
Kotschubeite
Penninite
Kämmererite
Prochlorite
Corundophyllite
Chalcodite
Jefferisite

Not Grouped.
Serpentine
Deweylite
Montmorillonite
Talc
Pyrophyllite
Allophane
Sepiolite
Celadonite
Kaolinite
Rectorite
Halloysite
Cimolite
Chrysocolla
Chloropal
Nontronite
Stratopeite
Pilinite

Titano-silicates.
Titanite
Benitoite
Neptunite

194. GYROLITE.

Hydrous silicate of calcium, $H_2Ca_2Si_8O_9.H_2O$.

Fibrous and lamellar concretions. Colorless and white. Vitreous luster. H=3—4; G=2.39.

Formed as a secondary mineral in crevices of rocks by the alteration of lime silicates.

San Francisco County: Occurs lining fissures in the rock at Fort Point and was analysed by Schaller[6].

SiO_2	Al_2O_3	CaO	Na_2O	Ign.	
53.47	0.22	32.00	1.25	13.21	=100.15%

Santa Clara County: Fibrous gyrolite occurred in the crevices of the cinnabar mine at New Almaden, associated with apophyllite and bituminous matter, which was analysed by Clarke[2].

SiO_2	$Al_2O_3Fe_2O_3$	CaO	K_2O	Na_2O	F	Ign		F—O	
52.54	0.71	29.97	1.56	0.27	0.65	14.60	=100.30	—0.27	=100.03%

195. APOPHYLLITE.

Hydrous silicate of calcium and potassium, $H_7KCa_4(SiO_3)_8.4\frac{1}{2}H_2O$.

Tetragonal. Square prisms, pyramids, massive. Cleavage perfect basal. Colorless, white, pale violet, greenish, yellowish. Pearly luster on base. H=4.5—5; G=2.3—2.4.

A secondary mineral found in cavities of volcanic rock.

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San Francisco County: A few crystals were found at Fort Point with the forms (111) and (100), but most of them were largely changed into quartz pseudomorphs, Schaller[3].

Santa Clara County: Found at New Almaden in large crystals associated with gyrolite and bituminous matter, Clarke[2].

196. OKENITE.

Hydrous silicate of calcium, $H_2CaSi_2O_6+H_2O$.

Finely fibrous and acicular. Color snow-white. Luster pearly. H=4.5—5; G=2.28.

Riverside County: The wilkeite in the limestone at Crestmore is often altered to a white fibrous material, which has been identified as okenite by its optical properties. Eakle and Rogers[1].

197. HEULANDITE.

Hydrous silicate of calcium and aluminium, $H_4CaAl_2(SiO_3)_6.3H_2O$.

Monoclinic. Platy crystals. Color white, brick-red. Perfect clinopinacoidal cleavage. H=3.5—4; G=2.18—2.2.

A zeolite formed as a secondary mineral in cavities and seams of basic volcanic rock, usually with stilbite, chabazite and other zeolites. It is probably present in the basaltic areas of the State, but has not been reported.

San Diego County: Occurs sparingly as pale brown crystals with stilbite at Rincon. Forms: (010), (001), (201), ($\bar{2}$01), (110), Rogers[3].

198. LAUMONTITE.

Hydrous silicate of calcium and aluminium, $H_4CaAl_2Si_4O_{14}.2H_2O$.

Monoclinic. Radiating or divergent columnar. Cleavage perfect basal and clinopinacoidal. Color white. Vitreous luster. H=3.5—4; G=2.25—2.36.

A zeolite occurring in cavities of basic volcanic rock, usually with other zeolites.

San Bernardino County: Fibrous white laumontite has been found near the Grant mine, on the right bank of the Cucamonga Canyon.

San Diego County: Small amounts are associated with the axinite crystals of Moosa Canyon near Bonsall, Schaller[1]. The mineral also occurs at Rincon in minute radiate crystals with the forms (110), and (201), and as a pseudomorph after stilbite, Rogers[3].

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199. STILBITE.

Hydrous silicate of sodium, calcium and aluminum, $H_4(Na_2,Ca)Al_2Si_6O_{18}.4H_2O$.

Monoclinic. Commonly in sheaf-like aggregates, lamellar. Cleavage perfect clinopinacoidal. Color white, yellowish brown. Vitreous to pearly luster. H=3.5—4; G=2.09—2.20.

A common zeolite occurring usually as sheaf-like aggregates in cavities and seams of volcanic rock. It is more common than what has been reported.

Fresno County: Found in lava in the North Fork mining district.

Modoc County: Specimens of lava with amygdules filled with stilbite and natrolite have come from this county.

San Diego County: Occurs as sheaf-like aggregates of small brown crystals at the Victor mine near Rincon, Rogers[3].

Santa Barbara County: Found in the San Pablo Mountains of Santa Rosa Island.

Tulare County: Occurs in volcanic rock at Mount Kaweah.

200. CHABAZITE.

Hydrous silicate of calcium, sodium and aluminium $(Ca,Na_2)Al_2Si_4O_{12}.6H_2O$.

Hexagonal, rhombohedral. Crystals nearly cubic. Color white, flesh-red. Vitreous luster. H=4—5; G=2.08—2.16.

A zeolite occurring as a secondary mineral in cavities of basic volcanic rock, usually in rhombohedrons nearly cubic in shape.

Nevada County: Occurs in colorless crystals with epidote and pyrite at the Star placer mine, Grass Valley, Lindgren[6].

Plumas County: Found as rhombohedrons in olivine basalt at the Dodson mine, Mooreville Ridge, Turner[1].

201. ANALCITE.

Hydrous silicate of sodium and aluminium, $NaAlSi_2O_6.H_2O$.

Isometric. Crystals usually trapezohedrons. Sometimes quite large. Colorless to white. Vitreous luster. H=5—5.5; G=2.22—2,29.

A zeolite occurring as a secondary mineral in volcanic rocks and often in large trapezohedral crystals. It is also found as an original constituent in some diabases and basalts.

Alameda County: Occurs as one of the secondary minerals in the cavities of andesitic rock on the Berkeley Hills.

Santa Barbara County: A constituent of the teschenite of Point Sal and was analysed by Fairbanks[3][4].

SiO_2	Al_2O_3	CaO	Na_2O	K_2O	Ign.		
54.40	23.04	0.21	13.33	0.19	8.46	=99.63	G=2.26

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202. NATROLITE.

Hydrous silicate of sodium and aluminium, $Na_2Al_2Si_3O_{10}.2H_2O$.

Orthorhombic. Long needles, columnar, fibrous. Cleavage perfect prismatic. Colorless to white. Vitreous luster. H=5 — 5.5; G=2.2 — 2.25.

A zeolite formed as a secondary mineral in cavities of igneous rock and sometimes as veins in such rock. It usually occurs fibrous or acicular, associated with stilbite and other zeolites.

Alameda County: Needles of natrolite occur with analcite in the amygdules of the andesitic rock on the Berkeley Hills.

Modoc County: Slender needles occur with stilbite in the lava of this county.

San Benito County: A large vein of white natrolite occurs near the headwaters of the San Benito River on the west side of the Diablo Range about twenty-five miles north of Coalinga, in which crystals of benitoite and neptunite are included. The natrolite is mostly granular although some crystals with the forms (110) and (111) occur. The occurrence has been described by Louderback[1][2] with analysis by Blasdale.

SiO_2	Al_2O_3	Na_2O	H_2O	
47.69	27.14	15.74	9.56	=100.13%

Sierra County: Found on Herkin's ranch north of Sierra.

Sonoma County: In the rocks of the Sonoma Mountains not far from Petaluma.

203. MESOLITE.

Hydrous silicate of sodium and calcium, $m\ Na_2Al_2Si_3O_{10}2H_2O\ n\ CaAl_2Si_3O_{10}.3H_2O$.

Triclinic. Prismatic crystals. Generally silky fibrous crusts. Cleavage perfect prismatic. Colorless to white. Vitreous to silky luster. H=5; G=2.2 — 2.4.

A zeolite occurring generally as silky fibrous crusts as a secondary mineral in cavities of basaltic rock.

Lassen County: Observed in the lava of Lassen Butte.

Shasta County: Found near Redding.

Ventura County: Observed in the basalt of the Pinos Mountains.

MICAS.

The mica family consists of a number of silicates, having various and complex compositions, which occur characteristically in thin elastic scales and plates. The common micas, muscovite and biotite, are very important rock-forming minerals of igneous and metamorphic rocks,

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and are to be found all over the State. There are several rare micas and alteration products of micas which have not been observed in California and will therefore not be mentioned.

204. MUSCOVITE—Potash Mica.

Hydrous silicate of potassium and aluminium, essentially $(H,K)AlSiO_4$.

Monoclinic. Hexagonal-shaped plates, plumose aggregates, scales. Cleavage perfect basal. Colorless, gray, brown, pale green. Vitreous luster. H=2—2.5; G=2.76—3.

Muscovite is a common constituent of granites, syenites, gneisses and schists. It is generally called mica or isinglass and is of economic value when in large transparent sheets. Extensive areas of mica-schists occur in the State in which muscovite is the principal constituent and gives the rock its schistose structure.

Sericite is a soft greasy-feeling muscovite forming mostly sericitic schists.

Fuchsite is a chrome-muscovite of an emerald green color.

Pinite and Agalmatolite are names given to compact muscovite or altered muscovite, usually of gray or white color.

205. MARIPOSITE.

Monoclinic. Micaceous, scales, foliated massive. Cleavage perfect basal. Color apple-green, white. Vitreous luster. H=2.5—3; G=2.78—2.81.

Mariposite is essentially a muscovite with its characteristic green color due to the presence of chromic oxide. It is distinctly characteristic of the gold belt of the Sierras and was described as a new mineral by Silliman[6].

206—PARAGONITE—Soda Mica.

Silicate of sodium and aluminium, $H_2NaAl_3Si_2O_{12}$.

Massive, compact, scaly. Cleavage perfect basal. Color gray, yellowish gray, pale green. Pearly luster. H=2.5—3; G=2.78—2.90.

The rocks of the Coast Ranges are notably rich in soda and this mica has been observed as one of the constituents of the schists.

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207. LEPIDOLITE—Lithia Mica.

Silicate of lithium, potassium, fluorine and aluminium $(KLi)Al(OH,F)\ Al(SiO_3)_3$.

Monoclinic. Commonly in scaly masses; sometimes in broad plates. Cleavage perfect basal. Color lilac, lavender, violet-blue, pink to colorless. Vitreous to pearly luster. H=2.5—4; G=2.8—2.9.

Lepidolite occurs in scaly masses of a lavender, violet and pink color. It is the characteristic mica of pegmatitic veins which carry red and green tourmaline.

Cookeite is a hydrous lithia mica, white to yellowish green in color.

208. BIOTITE—Magnesia Mica.

Silicate of magnesia, iron and aluminium $(H,K)_2(Mg,Fe)_4(Al,Fe)_2Si_4O_{16}$.

Monoclinic. Broad plates, foliated, scaly, micaceous. Cleavage perfect basal. Color black, dark brown, green. Vitreous to pearly luster. H=2.5—3; G=2.7—3.1.

The dark brown and black biotite mica is the commonest of all the micas. It is generally a prominent constituent of nearly all eruptive rocks and also of gneisses and schists. It is present as a rock-forming mineral in every county.

Lepidomelane—Iron Mica.

Monoclinic. Broad plates, scales, micaceous. Cleavage perfect basal. Color iron-black. Adamantine to vitreous luster. H=3; G=3—3.2.

Black lepidomelane is similar to biotite in composition and appearance, but is richer in iron. It is usually classed as biotite.

Alpine County: A black biotite from a quartz-monzonite rock at Blood Station was analysed by Valentine, Turner[7].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	SrO	BaO	MgO	Li_2O
35.62	2.61	15.24	4.69	13.67	0.74	0.95	tr.	0.26	12.70	tr.

Na_2O	K_2O	H_2O at 105°	H_2O ab. 105°	P_2O_5	F	
0.50	7.72	0.94	4.36	none	none	=100.00%

Amador County: Biotite from a pyroxene gneiss on the north fork of the Mokelumne River was analysed by Valentine, Turner[7].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	SrO	BaO	MgO	Li_2O	Na_2O
36.62	3.03	14.37	4.04	17.09	0.40	1.48	tr.	0.33	9.68	tr.	0.45

K_2O	H_2O at 105°	H_2O ab. 105°	P_2O_5	F		O=F	
8.20	0.90	3.26	none	0.10	=99.95	—0.04	=99.91%

El Dorado County: According to Hanks[6] some material resembling agalmatolite occurred in a vein at Greenwood.

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Inyo County: Muscovite is found in the Saratoga district.

Lassen County: Muscovite was early reported from Susanville.

Mariposa County: 1. Black biotite from biotite-granite of El Capitan, Yosemite Valley, was analysed by Valentine; and, 2. Brown biotite from quartz-monzonite on Tioga road, southeast of Mount Hoffman, was analysed by Hillebrand, Turner[7].

	SiO_2	TiO_2	Al_2O_3	V_2O_3	Cr_2O_3	Fe_2O_3	FeO	MnO	NiO	CoO	CaO	SrO
1.	35.64	1.12	18.62	--	--	5.54	14.60	0.79	--	--	0.90	--
2.	35.75	3.16	14.70	0.05	tr.	4.65	14.08	0.45	0.02		0.17	?

					H_2O				
BaO	MgO	Li_2O	Na_2O	K_2O	at 100°	ab. 100°	P_2O_3	F	O=F
tr.	9.72	tr.	0.38	9.22	0.48	2.54	0.20	0.26	=100.01 — 0.11 = 99.90%
0.12	12.37	--	0.32	9.19	1.03	3.64	0.03	0.17	= 99.90 — 0.07 = 99.83%

The green mica, mariposite, is common in the Mother Lode schists of this county and of Tuolumne and Calaveras counties, and it was first described by Silliman[6] as a new mineral. The mineral from the Josephine mine was analysed by Hillebrand, Turner[4].

	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	CaO	MgO
Green	55.35	0.18	25.62	0.18	0.63	0.92	0.07	3.25
White	56.79		25.29	none		1.59	0.07	3.29

K_2O	$(Li,Na)_2O$	H_2O	
9.29	0.12	4.52	=100.13%
8.92	0.17	4.72	=100.84

Nevada County: Sericite and biotite are mentioned by Lindgren[6] as constituents of the rocks of Grass Valley and Nevada City.

Orange County: Fuchsite has been found at Arch Beach.

Riverside County: Muscovite and lepidolite occur with the gem tourmaline at Coahuila.

San Bernardino County: Cookeite has been reported from Oro Grande.

San Diego County: Muscovite is a common mineral in the pegmatite veins which carry the gem tourmaline and kunzite of this county. Crystals occur at the Mack mine, Rincon, with the forms: (001), (010), (221), Rogers[2].

Pink muscovite from Mesa Grande has been analysed by Schaller[7].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Li_2O	Na_2O	K_2O
45.63	tr.	37.42	tr.	0.06	none	none	0.20	1.43	9.95

H_2O	F	O=F	
4.43	0.77	=99.89 — 0.32	=99.57%

Lepidolite mica ranging in color from gray through lavender and rose to deep violet is the common mica associated with the gem tourmaline of the county. Good crystals were found four miles east of Ramona having the forms: (001) (010), (100), (023), (112), ($\bar{1}$11), (132), (130), ($\bar{2}$23), ($\bar{2}$21) ?, ($\bar{1}$12) ?, Schaller[6]. Coarse and fine scaly lepidolite is common at the Victor mine, Rincon, and crystals have the forms (001), (100), (010), ($\bar{1}$31), Rogers[2]. The lepidolite of Pala and of Mesa Grande has been analysed by Schaller[7]. 1. Red

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purple from Pala, Tourmaline Queen mine; 2. Blue purple from Pala; 3. Purple; 4. White; 5. Lepidolite border on muscovite from Mesa Grande.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	Mn_2O_3	MnO	MgO	CaO	Li_2O	Na_2O
1.	51.12	22.20	0.80	--	1.34	--	--	--	5.12	2.28
2.	50.95	23.97	0.82	--	1.29	--	--	--	4.63	2.39
3.	50.34	28.71	0.11	tr.	--	0.50	none	tr.	2.39	1.59
4.	51.25	25.62	0.12	none	--	0.05	none	tr.	4.31	1.91
5.	50.85	26.78	0.60	--	--	0.07	tr.	0.10	4.27	1.41

K_2O	H_2O	P_2O_5	F	O=F	
10.00	2.05	0.04	6.38	=102.43 — 2.69=	99.74%
10.69	1.91	0.04	6.11	=102.80 — 2.57=	100.23
10.37	3.15	--	5.02	=102.18 — 2.11=	100.07
10.65	1.60	--	7.06	=102.60 — 2.97=	99.63
10.30	1.74	--	6.71	=102.83 — 2.82=	100.01

Cookeite from Pala has also been analysed by Schaller[7].

SiO_2	Al_2O_3	MnO	MgO	CaO	Li_2O	Na_2O	K_2O	H_2O at 105°	H_2O ab. 105°
35.53	44.23	tr.	tr.	tr.	2.73	2.11	0.31	0.61	13.57

F	O=F	
1.46	=100.55 — 0.61=	99.95%

Colorless and deep pink cookeite is found in pockets at the Victor mine, Rincon, coating quartz, lepidolite, orthoclase, albite and kunzite, and as pseudomorphs after kunzite, Rogers[3].

Santa Clara County: Paragonite is mentioned as a constituent of eclogite at Coyote Creek, near San Martin and of greenstone on San Francisquito Creek, J. P. Smith[1].

Sierra County: Mariposite is found at the Rainbow mine.

Tuolumne County: Mariposite is common at the Rawhide Ranch mine near Tuttletown.

Ventura County: Good sheets of muscovite have come from the Mount Almo mica mine.

209. ROSCOELITE—Vanadium Mica.

Hydrous silicate of vanadium, aluminum and potasium, $H_2K(Mg,Fe)(Al,V)_4(SiO_3)_{12}$.

Minute scales often in stellate groups. Cleavage perfect basal. Color clove-brown, greenish brown or brownish green. Pearly luster. Soft. G=2.92 — 2.94.

Vanadium is a rare constituent of some igneous rocks, and is occasionally found in small amounts in biotite. Roscoelite is unique in having a large percentage of vanadium in place of iron and thus forming a vanadium-mica. It is a very rare mica, and few specimens of it are now in existence, since most of the material was destroyed for the gold which was thickly interlaminated with the micaceous plates.

El Dorado County: Layers from a tenth to a half inch in thickness of a dark green micaceous mineral, thickly interlaminated with gold,

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were found at the Stuckslager or Sam Sim's mine on Granite Creek, near Coloma, which proved to be a new mineral and was named by James Blake[2], in 1874. The new mica was later described and analysed by Genth[6], Roscoe[1], and Hillebrand, Turner and Clarke[1].

	SiO_2	TiO_2	V_2O_3	V_2O_5	V_6O_{11}	Al_2O_3	Fe_2O_3	Mn_2O_3	FeO
Genth --	47.82				21.36	12.60			3.30
	47.69				22.02	14.10			1.67
Roscoe ----	41.25			28.60		14.14	1.13	1.15	
Hillebrand-	45.17	0.78	24.01			11.54			1.60

MgO	CaO	Na_2O	K_2O	Li_2O	H_2O		
2.43	tr.	0.33	8.03	tr.	5.13	=100.00%	
2.00	tr.	0.19	7.59	tr.	4.96	=100.22	G=2.938
2.01	0.61	0.82	8.56		3.35	=101.62	
1.64	--	0.06	10.37	tr.	4.69	= 99.86	

Several hundred pounds of the mineral were also found in Big Red Ravine, near the old Sutter Mill, where gold was first discovered, but the masses were destroyed for their gold values, Hanks[6].

BRITTLE MICAS.

The brittle micas include several micaceous minerals whose plates or scales are non-elastic and easily break when bent. Otherwise they resemble the common micas. They are characteristic of the crystalline gneisses and schists. All of them probably occur in the State, but only margarite, xanthophyllite, chloritoid, and ottrelite have been observed.

210. MARGARITE.

Hydrous silicate of calcium and aluminium, $H_2Ca_2Al_4Si_2O_{12}$.

Monoclinic. Scaly, micaceous. Cleavage perfect basal. Color grayish. pink. Pearly luster. H=3.5 — 4.5; G=2.99 — 3.08.

Margarite is prominent in the glaucophane rocks and has been observed in several localities.

Calaveras County: Soft silver-white pearly masses of flaky material occur in the Gold Cliff mine at Angels and in some of the other mines of the Mother Lode which bear a strong resemblance to margarite, and are probably this mineral.

Marin County: Mentioned by Ransome[2] as an associate of the lawsonite at Reed Station. Much of this, however, is muscovite, Eakle[6].

San Mateo County: A constituent of the schists of Belmont, Murgoci[1].

Santa Clara County: Occurs in the eclogite of Oak Ridge, J. P. Smith[1].

Sonoma County: A constituent of the glaucophane gneiss of Melitta, near Santa Rosa, Murgoci[1].

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211. XANTHOPHYLLITE.

Hydrous silicate of aluminium, calcium and magnesium, $H_8(Mg,Ca)_{14}Al_{16}Si_5O_{52}$.

Monoclinic. Tabular crystals parallel to the base. Perfect basal cleavage. Color leek-green, bottle-green. Vitreous luster. H=4.6; G=3.09.

A very rare green platy mineral belonging to the brittle micas, resembling green muscovite.

Riverside County: Abundant platy crystals of xanthophyllite occurred in the blue calcite of the cement quarry at Crestmore, intimately associated with monticellite. An analysis by Eakle gave:

SiO_2	Al_2O_3	FeO	CaO	MgO	H_2O		
16.84	44.68	2.85	14.14	16.24	5.07	= 100.62%	G=3.081

212. CHLORITOID.

Hydrous silicate of iron, magnesium and aluminium, $H_2(Fe,Mg)Al_2SiO_7$.

Monoclinic. Foliated massive, scales. Cleavage perfect basal. Color dark gray, grayish black, grass green. Pearly to vitreous luster. H=6.5; G=3.52 — 3.57.

Calaveras County: Dark green chloritoid has been found in some of the schists of this county.

213. OTTRELITE.

Hydrous silicate of iron, manganese and aluminium, $H_2(Fe,Mn)Al_2Si_2O_9$.

Monoclinic. Hexagonal-shaped scales. Cleavage perfect basal. Color blackish gray, black. Vitreous luster. H=6 — 7; G=3.3.

Ottrelite schists appear to be rare in the State.

Siskiyou County: A specimen of ottrelite schist has come from the vicinity of Yreka.

CHLORITES.

Under the name chlorite are included several species having a micaceous structure with the flakes flexible but not elastic. The chlorites are prominent in many schists, forming chlorite-schists. They are also formed as secondary alteration products of hornblende and pyroxene rocks, and as such are very common throughout the State. They are characteristically dark leek-green or brown in color. As a general thing the various kinds of chlorite have not been differentiated.

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214. CLINOCHLORE.

Hydrous silicate of magnesium and aluminium, $H_8Mg_5Al_2Si_3O_{18}$.

Monoclinic. Scaly, earthy, compact. Cleavage perfect basal. Color deep grass-green, olive-green, rose-red. Pearly luster. H=2—2.5; G=2.65—2.78.

Clinochlore occurs as an alteration product of magnesian-iron minerals and is common in schists.

Kotschubeite is a rose-red variety of clinochlore containing chromium and is associated with chromite in serpentine rocks.

215. PENNINITE—Rhodochrome.

Hydrous silicate of iron, magnesium and aluminium, $H_8(Mg,Fe)_5Al_2Si_3O_{18}$.

Monoclinic. Plates, scales, scaly massive. Cleavage perfect basal. Color emerald-green, grass-green, violet, rose-red. Pearly luster. H=2—2.5; G=2.6—2.85.

Penninite is similar to clinochlore with more iron in its composition. *Kämmererite* is a peach-blossom red variety associated with chromite.

216. PROCHLORITE.

Hydrous silicate of magnesium, iron and aluminium.

Monoclinic. Scaly, foliated, granular, massive. Cleavage perfect basal. Color green, blackish green, brown. Pearly luster. H=1—2; G=2.78—2.96.

Prochlorite is a common chlorite of rocks usually dark green but sometimes brown. Forms large flaky masses in schists.

217. CORUNDOPHYLLITE.

Hydrous silicate of magnesium and aluminium.

Monoclinic. Plates, lamellar massive. Cleavage perfect basal. Color olive-green, leek-green. Pearly luster. H=2.5; G=2.9.

This is a rarer form of chlorite, but probably exists in more localities than are now known.

218. CHALCODITE.

Hydrous silicate of iron, magnesium and aluminium.

Minute scales. Color black, yellowish and greenish bronze. Brassy to submetallic luster. Flexible. H=3—4; G=2.96.

Chalcodite is a rare brown chlorite, occurring in minute scales, often with a bronze luster.

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219. JEFFERISITE.

Hydrous silicate of magnesium, iron and aluminium.

Broad plates, small scales. Cleavage perfect basal. Color dark yellowish brown. Pearly luster. H=1.5; G=2.30.

Jefferisite is a hydrated mica occurring in dark yellowish brown scales and plates.

Alameda County: Reddish violet kämmererite occurs with chromite on Cedar Mountain at the Mendenhall mine, Rogers[5].

Butte County: Prochlorite is a constituent of the schists at Forbestown, specimens coming from the Gold Bank mine.

Contra Costa County: Prochlorite was described and analyzed from the schists near San Pablo by Blasdale[1].

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	H_2O at 100°	H_2O ab. 100°	
27.38	26.15	0.78	12.70	18.92	--	1.15	1.51	11.44	=100.03%

Del Norte County: Kämmererite has been observed coating chromite from this county.

Lassen County: Large brown plates of jefferisite occur at Susanville according to Hanks[4].

Mendocino County: Small flakes have been observed in this county.

Placer County: Kämmererite occurs on chromite in Green Valley above Dutch Flat.

Rose-red kotschubeite also occurs on chromite in the serpentine of Green Valley, above Dutch Flat, Lindgren[2]. It has been analysed by Melville[1].

SiO_2	Al_2O_3	Cr_2O_3	FeO	NiO	CaO	MgO	H_2O at 105°	H_2O ab. 105°
31.74	6.74	11.39	1.23	0.49	0.18	35.18	0.37	12.68

Riverside County: Corundophyllite has been found at Roggentramp. Clinochlore occurs in pale green flakes with vesuvianite in the limestone at Crestmore.

San Benito County: Red kämmererite occurs on chromite associated with uvarovite at New Idria, Brush[1].

Santa Barbara County: Brown crystals of chalcodite have come from this county.

Tulare County: Hanks[6] mentions jefferisite from this county.

220. SERPENTINE.

Hydrous silicate of magnesia, $H_4Mg_3Si_2O_9$.

Monoclinic. Commonly massive, compact to fibrous. Color leek-green, oil-green, brown, black. Greasy luster. Feels smooth, sometimes greasy. H=2.5—4; G=2.5—2.65.

Serpentine is one of the commonest minerals and also rocks of the State. It occurs in every county, and probably all the varieties are

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present. It is a common alteration product of basic igneous rocks rich in magnesian silicates, and it has all been formed by alteration and metamorphism of such rocks. Besides the ordinary massive serpentine, *retinolite, porcellophite, marmolite, chrysotile, picrolite* and *metaxite* have been observed in petrographical literature. The only variety of commercial importance is the fibrous or asbestiform variety known as chrysotile, or asbestos, which occurs as narrow veins in the massive material mostly too narrow to be of value. The massive serpentine ranges in color from light green to greenish black but very little of it can be utilized as an ornamental stone on account of its foliated and sheared structure. Turner and Melville[1] give several analyses of serpentine rock from Mount Diablo.

Serpentine is abundant in the Coast Range from San Diego to Del Norte County and also on the west flank of the Sierras.

Amador County: A fine mottled serpentine occurs 1½ miles west of Sugar Loaf Mountain. Broad sheets and long fibers of chrysotile occur in serpentine in the American River Canyon near Towle.

El Dorado County: Veins of fibrous chrysotile are found at Forest Hill.

Inyo County: Long fibers of asbestos occur at Cerro Gordo.

Lake County: Becker[1] gives analyses by Melville of the serpentine at Sulphur Bank. 1. Black; 2. Light green.

	SiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	NiO	CaO	MgO	H_2O	
1.	39.64	1.30	0.29	7.76	0.12	0.33	--	37.13	13.81	=100.38%
2.	41.86	0.69	0.24	4.15	0.20	tr.	--	38.63	14.16	= 99.93

Mariposa County: Small veins of chrysotile occur in the serpentine near Mariposa.

Nevada County: Massive serpentine is common in the Grass Valley and Nevada City region. Zones of short fibrous chrysotile occur in the Washington district on the South Yuba River.

Placer County: Long fibers of chrysotile occur at Wisconsin Hill, Iowa Hill and Arizona Flat.

Plumas County: Diller[3] gives an analysis by Melville of serpentine from Greenville.

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	H_2O	
39.14	2.08	4.27	2.04	tr.	39.84	12.70	=100.07%

San Benito County: Becker[1] gives an analysis by Melville of a light green marmolite from New Idria.

SiO_2	Al_2O_3	FeO	NiO	CaO	MgO	H_2O	
41.54	2.48	1.37	0.04	--	40.42	14.18	=100.03%

San Francisco County: Newberry[1] gives an analysis of the serpentine of San Francisco.

SiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	CaO	MgO	H_2O	
39.60	1.94	0.20	8.45		--	36.90	12.91	=100.00%

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Santa Clara County: Small veins of chrysotile occur in the serpentine near New Almaden.

Shasta County: Large fibrous masses of chrysotile asbestos occur near Simon's Station.

Tulare County: A chrysotile variety giving cat's-eye effect and called "satelite" comes from this county.

Tuolumne County: The serpentine near Chinese and Montezuma contains small veins of chrysotile.

221. DEWEYLITE.

Hydrous silicate of magnesium, $4MgO.3SiO_2.6H_2O$.

Amorphous. Massive, gum-like. Color whitish, yellowish, reddish. Greasy luster. H=2—3.5; G=2—2.2.

A whitish clay-like mass with greasy luster. Its occurrence in the State may be more general than is known.

Santa Clara County: At the big magnesite mine on Red Mountain, crusts of deweylite have been found and described by Rogers[5].

Shasta County: Specimens resembling deweylite have come from this county.

222. MONTMORILLONITE.

Hydrous silicate of aluminium, $H_2Al_2Si_4O_{12}.nH_2O$.

Massive, clay-like. Color rose-red. Soft.

A massive clay-like mineral indistinguishable from clay except by analysis.

Inyo County: Found in Death Valley.

San Diego County: Some of the pink clay associated with the tourmaline of Pala may be in part montmorillonite. Mentioned by Goodyear[1] as forming a deposit about three miles northeast of Otay. This white to reddish soapy material is classed as a rock soap.

223. TALC—Steatite—Soapstone.

Hydrous silicate of magnesium, $H_2Mg_3Si_4O_{12}$.

Monoclinic. Foliated massive to granular and compact massive. Color gray, white, pale green, apple-green, brown. Greasy luster and feel. H=1—1.5; G=2.7—2.8.

Talc is a very common mineral in the metamorphic areas of the State, forming talc schists and talc gouge in mines. It occurs as a hydration

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product in the alteration of magnesian silicates, and is often associated with serpentine and with actinolite. The massive soapstone variety is of value and some is quarried in the State. The location of some of the deposits is given by Aubury[3], but most of them are of little value.

Alameda County: Light green talc outcrops in the serpentine about twenty miles southeast of Livermore.

Amador County: Talc occurs in the schists near Jackson.

Butte County: Soapstone occurs in the vicinity of Flea Valley and Clear Creek. Narrow seams of talc occur in the Big Bend of the North Fork of the Feather River. Gray soapstone near Buck's ranch.

Calaveras County: Talc seams are found two miles northeast of Angels and on Quail Hill. Deposits 2½ miles west of Murphys and 1½ miles southwest of Vallecito have been utilized to some extent.

Contra Costa County: An analysis of the talc from the schists near San Pablo was made by Blasdale[1].

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	H_2O at 100°	H_2O ab. 100°	
56.02	9.02	1.10	5.14	24.10	0.60	0.16	4.34	=100.48%

El Dorado County: In the Kelsey district and at Georgetown some talc occurs.

Glenn County: Talc seams occur with the serpentine on the eastern border of the county.

Kern County: Steatite occurs on Soapstone Mountain.

Los Angeles County: Soapstone is found with serpentine at Empire Landing, Santa Catalina Island.

Marin County: Some talc is found near San Rafael and Taylorville.

Mariposa County: Small amounts of talc are found near Princeton, and in the Lewis district.

Napa County: Seams of talc with serpentine are found in the Chiles district.

Nevada County: Specimens occur in the Grass Valley region.

Placer County: Outcrops of talc occur a few miles north of Colfax.

Riverside County: A white, scaly talc occurs about three miles southwest of Winchester, and near Perris.

Sacramento County: Talc occurs with chromite on Bear Mountain, near Mormon Island.

San Bernardino County: A talcose clay called "rock soap" is found near Waterman.

San Diego County: A rock soap is found near National City, at Otay and in Tia Juana Valley. Steatite specimens come from about five miles from Escondido.

Santa Barbara County: Rock soap occurs on the Santa Maria River.

Santa Cruz County: Some talc occurs near Aptos.

Shasta County: Talc is found on Boulder Creek.

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Sierra County: Soapstone suitable for slabs has been quarried near Pike City.

Siskiyou County: Talc occurs in several localities associated with the serpentine areas of the county. It is found near Etna, near Fort Jones, near the head of Wolley Creek, near Scott, and in the Cottonwood Mountain.

Sonoma County: A soft green talc is associated with actinolite at Petaluma. A French chalk variety is found at Pine Flat.

Trinity County: Light gray soapstone occurs on Brown's Mountain.

Tulare County: Specimens of talc are found near Visalia.

Tuolumne County: A greenish white talc is found about nine miles north of Sonora. Talc also occurs at Shaw's Flat and on Yankee Hill.

Yuba County: Soapstone has been quarried for local use near Camptonville and in the vicinity of Challenge, and Oak Valley.

224. PYROPHYLLITE.

Hydrous silicate of aluminium, $H_2Al_2Si_4O_{12}$.

Monoclinic. Radiating fibrous, compact granular, lamellar. Cleavage perfect basal. Color white, apple-green, light brown, gray. Pearly luster. H=1—2; G=2.8—2.9. Soft and greasy like talc.

Pyrophyllite resembles talc so closely in its properties that it is generally classed as talc. It occurs generally in schists and gneisses, often associated with cyanite.

Agalmatolite is an indurated talc or pyrophyllite often carved into small ornaments.

Alameda County: A radiating fibrous variety occurs near Irvington.

Marin County: A fibrous radiating pyrophyllite has been found on Mount Tamalpais.

Mariposa County: Gray masses of radiating, fibrous rosettes occur at Tres Cerritos, southwest of Indian Gulch, which have been described by Turner[4]. An analysis of the pyrophyllite from this locality has been made by H. C. McNeil.

SiO_2	Al_2O_3	Fe_2O_3	MgO	H_2O at 105°	H_2O ab. 105°	TiO_2	
65.96	28.25	0.18	none	0.14	5.27	tr.	=99.80%

Plumas County: Some pyrophyllite occurs at the Diadem Lode, Meadow Valley.

San Diego County: A mottled pyrophyllite occurs near San Diego. A compact cream-colored agalmatolite with dark red streaks occurs near Encinitas, Rogers[5].

San Luis Obispo County: Some massive pyrophyllite has come from this county.

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225. ALLOPHANE.

Hydrous silicate of aluminium, $Al_2SiO_5.5H_2O$.

Amorphous. Incrustations. Colorless, pale sky-blue, green, brown. Vitreous luster. H=3; G=1.85 — 1.89.

This is a rare amorphous mineral occurring as an incrustation.

San Luis Obispo County: A specimen has come from Arroya Grande.

226. SEPIOLITE—Meerschaum.

Hydrous silicate of magnesium, $H_4Mg_2Si_3O_{10}$.

Compact. Earthy texture and smooth feel. Color white. Dull luster. H=2—2.5; G=2. When dry floats on water.

Sepiolite occurs as a compact earthy white mineral with a smooth feel. When dry it floats on water. It is a valuable mineral, but its occurrence in California is doubtful.

Inyo County: Mentioned by Hanks[6] as possibly occurring at the Half Dollar mine.

Kern County: Reported to have been found in this county.

227. CELADONITE.

Hydrous silicate of iron, magnesium and potassium.

Earthy or in minute scales. Very soft. Color deep olive-green or apple-green. Greasy feel.

An earthy green mineral usually found in minute scales, having a greasy feel like talc.

San Mateo County: A specimen has come from near San Mateo.

228. KAOLINITE—Kaolin—Clay.

Hydrous silicate of aluminium, $Al_2O_3.2SiO_2.H_2O$.

Monoclinic. Occurs occasionally in scales and plates but is generally massive, earthy, clay-like. Color white, yellow, red brown. Vitreous to dull luster. H=2—2.5; G=2.6. Plastic.

Kaolinite forms the base of clays. It is derived by the alteration of rocks containing aluminium silicates, especially the feldspars, and most good clays come from the alteration of the potash feldspar, orthoclase. As clay it is usually quite impure with iron, sand and other impurities, thus giving rise to many varieties which may be suitable for one purpose and not for another. Clays possess more or less plasticity, the

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highly plastic kinds being used for pottery and chinaware while the sandy and less plastic kinds may make bricks and terra-cotta ware.

There are extensive deposits of clay in the State and Aubury[3] gives the location of some of them. Many analyses of clay are also available, but these analyses and the many occurrences of clay in the State are beyond the scope of this book.

Rock soap and *Mountain soap* are names applied to impure clay-like masses having a soapy feel. They belong perhaps under the species talc, halloysite, or montmorillonite.

Lithomarge is a finely compact variety which might be classed as a halloysite. Some has been found at the old Redington mine, Knoxville, Napa County.

Fuller's earth is a sort of non-plastic clay suitable for decolorizing and purifying fats and oils.

229. RECTORITE.

Hydrous silicate of aluminium, $Al_2O_3.2SiO_2.H_2O$.

Monoclinic. In leaves like mountain leather. Soft with soapy feel. Color white. Pearly luster.

This mineral exists as white, pearly scales with a greasy feel. It is a rare mineral.

Amador County: Found in pearly scales near Ione by Turner[1] and analysed by Hillebrand.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	K_2O	Na_2O	H_2O at 100°	H_2O ab. 100°	
55.88	0.50	30.24	0.45	0.16	tr.	0.42	0.34	0.63	11.72	=100.31%

Calaveras County: A mineral similar in appearance has been found in the gangue of the mines at Angels and elsewhere in the Mother Lode.

230. HALLOYSITE.

Hydrous silicate of aluminium, $H_4Al_2Si_2O_9.H_2O$.

Massive. Earthy clay-like masses. Color white, gray, greenish, reddish. Waxy luster. Slightly plastic. H=1—2; G=2—2.2.

A clay-like material occurring in masses which are indistinguishable from ordinary clay except by an analysis. It is usually less plastic than clay.

Lenzinite is a compact "rock soap" form of halloysite or clay.

Inyo County: Lenzinite has been reported from Owens Valley by Hanks[6]. A banded white and brown halloysite occurs at the Cerro Gordo mine, Rogers[5].

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Lassen County: Halloysite occurs at Heyden Hill.

Mono County: Halloysite was analysed from the Detroit mine, near Mono Lake, by Clarke[1].

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	H_2O	
42.91	38.40	tr.	0.60	1.50	18.00	=101.05%

San Diego County: Massive pink halloysite occurs at Pala with the gem tourmaline and has been analysed by Schaller[3].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	Li_2O	Na_2O	K_2O	
43.62	none	35.55	0.21	0.26	1.02	0.19	0.23	0.19	0.03	
						H_2O				
						at 107°	ab. 107°			
						6.63	12.25			=100.18%

Ventura County: An analysis of lenzinite from this county has been made by Merrill.

231. CIMOLITE.

Hydrous silicate of aluminium, $2Al_2O_3.9SiO_2.6H_2O$.

Amorphous. Clay-like or chalky. Color white, grayish or reddish. Soft. G=2.18—2.30.

An amorphous clay-like or chalky mineral of rare occurrence.

Lake County: Found in the Uncle Sam quicksilver mine, near Clear Lake.

232. CHRYSOCOLLA.

Hydrous silicate of copper, $CuSiO_3.2H_2O$.

Cryptocrystalline. Opal-like, earthy, incrustations. Color bluish green, turquois-blue. Vitreous to dull luster. H=2—4; G=2—2.24.

Small amounts of chrysocolla occur in most of the copper districts of the State, but there are no deposits of the silicate. It occurs as an oxidation product of copper minerals, and is usually a stain or incrustation.

Amador County: Common at Volcano.

Calaveras County: Common as a staining material at Campo Seco and at Copperopolis.

Fresno County: Found at the Ne Plus Ultra mine.

Inyo County: Common at the Cerro Gordo mines. Occurs pseudomorph after limonite at the Aries mine.

Los Angeles County: Reported from the old Kelsey mine, San Gabriel Canyon by Storms[1].

Mariposa County: In streaks near Mariposa.

Mono County: Common at Lundy and Benton districts. With partzite at the Diana mine, Blind Springs district.

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Nevada County: Common with the copper of Meadow Valley and also at Spenceville.

Plumas County: Banded masses with malachite occur at the Engels mine, Light's Canyon and in the Mohawk Valley.

San Benito County: Small amounts occur with chalcocite in natrolite at the benitoite locality, Louderback[2].

San Bernardino County: Common in the Calico and Bismark districts, Lindgren[4]. Massive at the Copper World mine, Clarke Mountain.

San Diego County: Common in the Julian and Banner districts.

233. CHLOROPAL.

Hydrous silicate of iron, $H_8Fe_2Si_3O_{12}.2H_2O$.

Compact massive, opal-like. Color pistachio-green, greenish yellow. Dull luster. H=2.5 — 4.5; G=1.72 — 2.01.

Chloropal is a green, opal-like mineral of rare occurrence.

Nontronite is a yellowish variety.

El Dorado County: Nontronite was observed at Georgetown altered to limonite.

Kern County: Specimens of chloropal have come from the mountains east of Bakersfield.

Mariposa County: Nontronite has been found with garnet in this county.

Placer County: Specimens of chloropal have come from Bath.

234. STRATOPEITE—Neotocite.

Hydrous silicate of manganese and iron.

Amorphous. Color black to dark brown. Dull luster. H=3 — 4; G=2.64.

Sonoma County: A dark brown amorphous mineral with dull luster, supposed to be stratopeite has come from this county.

235. PILINITE.

Hydrous silicate of calcium and aluminium.

Found in felt-like masses resembling mountain leather and asbestos G=2.26.

Santa Clara County: Found on quartz at New Almaden.

Yuba County: Occurs at Smartsville.

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TITANO-SILICATES.

236. TITANITE—Sphene.

Titano-silicate of calcium, $CaTiSiO_5$.

Monoclinic. Wedge-shaped crystals, sometimes massive. Color brown, yellow, gray, yellowish green. Adamantine luster. H=5 — 5.5. G=3.4 — 3.56.

Titanite is a common accessory mineral of the granites, gneisses and schists of the State. It has been mentioned by most writers in their petrographical descriptions as a microscopic constituent of the rocks, and large crystals are seldom found.

Leucoxene is a grayish alteration product of ilmenite, rutile and titanite often observed in rocks containing those minerals.

Contra Costa County: Titanite is mentioned as an associate of crossite in the schists near San Pablo, by Palache[2].

El Dorado County: Titanite was first observed by Blake[7] in the granite of Slippery Ford and other places of the Sierras.

Fresno County: Titanite is a constituent of the rocks at Fine Gold Gulch.

Marin County: Occurs as one of the minerals of the lawsonite schists of the Tiburon Peninsular, Ransome[2].

Plumas County: Leucoxene is mentioned by Murgoci[1] in the syenite of Spanish Peak.

San Diego County: Titanite is an associate of dumortierite at Dehesa, Schaller[5].

San Francisco County: A constituent of the rocks of San Francisco, Lawson[2].

Santa Clara County: Fine large crystals occur in the eclogites of Calaveras Valley, in the quartzite and diorite of Oak Hill, near San Jose, and it is a common constituent of the glaucophane rocks of the Coastal region, Murgoci[1].

237. BENITOITE.

Titano-silicate of barium, $BaTiSi_3O_9$.

Hexagonal, rhombohedral. Prisms with trigonal pyramids. Colorless to deep blue. Vitreous luster. Transparent, strongly dichroic. H=6.5; G=3.64 — 3.65.

San Benito County: Colorless and beautiful sapphire-blue crystals of this new gem mineral were discovered in 1907 near the headwaters of the San Benito River, about twenty-five miles north of Coalinga and the mineral was described by Louderback[1],[2]. They show the forms: (0001), $(10\bar{1}0)$, $(10\bar{1}1)$, $(01\bar{1}1)$, $(11\bar{2}0)$, $(10\bar{1}2)$, $(22\bar{4}1)$, and are of tri-

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gonal habit. The crystals occur in a zone of narrow veins of natrolite in serpentine and have associated with them neptunite, chalcocite, chrysocolla, actinolite, crossite, albite, aegyrine, calcite, aragonite and psilomelane. Analyses of the mineral were made by W. C. Blasdale:

SiO_2	TiO_2	BaO	
43.56	20.18	36.34	=100.08%
			Sp. G.=3.64 — 3.67
43.79	20.00	36.31	=100.10

Additional notes on benitoite have been made by Baumhauer[2], Hlawatsch[1], Palache[4] and Rogers[2].

238. NEPTUNITE.

Titano-silicate of iron, manganese, potassium and sodium $(Na,K)_2(Fe,Mn)TiSi_4O_{12}$. Monoclinic. Prismatic crystals. Color black, in thin splinters blood-red. Streak cinnamon-brown. Vitreous luster. H=5 — 6; G=3.234.

San Benito County: Black crystals of neptunite accompany benitoite and these were first described by Louderback[1][2]. The crystals are deep blood-red in thin splinters and show the forms: (001), (100), (110), (111), ($\bar{1}11$), ($\bar{1}12$), ($\bar{2}11$), ($\bar{2}21$), ($\bar{3}11$).

An analysis was made by Blasdale:

SiO_2	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O	
53.44	17.18	11.23	1.78	0.25	1.82	5.39	9.14	=100.23%

The mineral was later analysed by Bradley[1]:

SiO_2	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O	
52.91	17.77	11.54	0.82	1.59	1.41	5.11	9.83	=100.98%
52.83	17.89	11.83	0.88	1.53	1.48	5.06	9.28	=100.78

Further notes on neptunite by Ford[2] and Schaller[10].

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CHAPTER X.

PHOSPHATES, VANADATES, ARSENATES, ANTIMONATES, NITRATES, BORATES, NIOBATES-TANTALATES, TUNGSTATES, MOLYBDATES AND URANATES.

Phosphates.
Monazite
Triphylite
Lithiophilite
Apatite
Pyromorphite
Amblygonite
Lazulite
Vivianite
Plumbogummite
Purpurite
Turquois
Hureaulite
Palaite
Stewartite
Salmonsite
Strengite
Sicklerite

Vanadates.
Pucherite
Vanadinite
Cuprodescloizite
Volborthite

Arsenates.
Mimetite
Erythrite
Annabergite
Scorodite
Liroconite
Pitticite

Antimonates.
Bindheimite

Nitrates.
Soda niter
Niter
Nitrocalcite
Darapskite
Nitroglauberite

Borates.
Ludwigite
Borax
Colemanite
Ulexite
Hydroboracite
Bakerite
Howlite

Niobates-tantalates.
Pyrochlore
Microlite
Columbite
Stibiotantalite

Tungstates.
Hübnerite
Wolframite
Scheelite
Cuproscheelite

Molybdate.
Wulfenite

Uranates.
Uraninite
Uraconite

PHOSPHATES.

The only phosphate of commercial importance as a source of phosphoric acid is the lime phosphate, represented by apatite and lime phosphate rock, deposits of which have not been found in the State. Masses of amblygonite occur, which have been mined for lithia, and veins and seams of turquois are mined for the gem, but the rest of the phosphates are very rare in the State.

239. MONAZITE.

Phosphate of cerium, lanthanum and didymium $(Ce,La,Di)PO_4$.

Monoclinic. Crystals rare. Commonly in grains as sand. Color yellowish brown, sometimes reddish. Vitreous to resinous luster. H=5 — 5.5; G=5.0.

Monazite has been detected in the black sands and concentrates from some of the mines but no deposits of this important mineral are known in the State. Its presence in the sands has been noted by Day and Richards[1].

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Butte County: Traces of monazite have been found in the black sands of Little Rock Creek.

Del Norte County: Observed in the sands at Crescent City and on Gilbert Creek.

El Dorado County: Traces have been found in the concentrates of the Brownsville district and at Placerville.

Humboldt County: Observed at Trinidad.

Placer County: Traces at Michigan Bluff.

Plumas County: Occurs in the sand at Nelson Point.

Yuba County: Traces in the Brownsville district.

240. TRIPHYLITE.

Phosphate of lithium and iron, $LiFePO_4$.

Orthorhombic. Commonly massive. Cleavage perfect basal. Color bluish gray, light blue, grayish green. Vitreous luster. H=4.5—5; G=3.42—3.56.

This rare phosphate usually contains manganese and grades into lithiophilite.

San Diego County: Found in the lithia mines at Pala associated with lithiophilite and purpurite, Graton and Schaller[1].

241. LITHIOPHILITE.

Phosphate of lithium and manganese, $LiMnPO_4$.

Orthorhombic. Commonly massive. Cleavage perfect basal. Color brown, salmon-pink. Vitreous luster. H=4.5—5; G=3.42—3.56.

San Diego County: Found with triphylite and purpurite as an alteration product of triphylite at Pala, Graton and Schaller[1].

242. APATITE.

Phosphate of calcium with chlorine or fluorine $(CaCl)Ca_4(PO_4)_3$ or $(CaF)Ca_4(PO_4)_3$.

Hexagonal. Prismatic crystals, granular, massive. Color brown, green, yellow, pink, colorless. Vitreous to greasy luster. H=5; G=3.17—3.23.

Apatite has been observed as small crystals in many of the rocks of the State, but no deposits of the mineral are known.

Contra Costa County: Found in brownish masses in the schists north of Berkeley.

Fresno County: Observed in the rocks near Dunlap.

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Plumas County: A constituent of the syenite of Spanish Peak, Murgoci[1].

San Diego County: Occurs in the gneiss at Dehesa with dumortierite, Schaller[5]. Tabular crystals of violet and pink colors occur at the old Mack mine near Rincon. At the Victor mine, Rincon, pale dirty green crystals occur with the forms: (0001), $(10\bar{1}0)$, $(11\bar{2}1)$, $(10\bar{1}2)$, $(10\bar{1}1)$, $(31\bar{4}1)$, Rogers[3]. Crystals are also found on South Mountain and at Mesa Grande.

San Francisco County: Mentioned by Lawson[2] in the rocks of San Francisco.

243. PYROMORPHITE.

Phosphate of lead with chlorine $(PbCl)Pb_4(PO_4)_3$.

Hexagonal. Prismatic crystals, columnar, massive. Color brown, yellowish green. Adamantine luster. H=3.5—4; G=6.5—7.1.

The lead phosphate is occasionally found in the mining districts as an oxidation product of galena and a few localities are known.

Calaveras County: Green crystals in gold quartz have been found at the Reliance mine.

El Dorado County: Occurred at Mosquito Gulch, six miles northeast of Placerville as a yellowish green coloring matter in botryoidal chalcedony and as a crystalline coating, Turner[8].

Inyo County: Found in small amounts in the Cerro Gordo district.

Mariposa County: A small amount was found in the mines near Coulterville.

Tulare County: Found in the White Chief mine, Mineral King district, Goodyear[1].

244. AMBLYGONITE.

Phosphate of lithium and aluminium with fluorine, $Li(AlF)PO_4$.

Triclinic. Generally massive. Cleavage perfect basal. Color white. Pearly to vitreous luster. H=6; G=3.10.

This is an important lithia mineral, and but one deposit is known in the State.

San Diego County: A large mass of white massive amblygonite occurs in the pegmatite vein carrying the rubellite and lepidolite and was mined at the Stewart mine, Pala. The mineral was analyzed by Schaller[3].

--	P_2O_5	Al_2O_3	Fe_2O_3	MnO	MgO	Li_2O	Na_2O	H_2O	
	48.83	33.70	0.12	0.09	0.31	9.88	0.14	5.95	
				F	TiO_2		O		
				2.29	none	=101.31 — 0.96			=100.35%

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A few small specimens of white cleavable amblygonite have been found at the Victor mine, Rincon, Rogers[3].

245. LAZULITE.

Basic phosphate of aluminium, iron and magnesium $(Fe,Mg)Al_2(OH)_2P_2O_8$.

Monoclinic. Sharp pointed pyramids, granular. Color azure-blue. Vitreous luster. H=5—6; G=3.05.

Lazulite is a rare phosphate found in quartzites and metamorphic rocks.

Inyo County: Lazulite occurs in a white quartz vein intersecting schist in Breyfogle Canyon, Death Valley.

Los Angeles County: Specimens have been found in the San Gabriel Mountains.

Mono County: Blue lazulite occurs as bands in a white quartzite associated with rutile, near Mono Lake.

Deep blue lazulite was found in a quartz vein in Green Creek Canyon, near Bodie, Rogers[5].

San Diego County: Some lazulite has been reported as found in the rock at Oceanside.

246. VIVIANITE.

Hydrous phosphate of iron, $Fe_3P_2O_8.8H_2O$.

Monoclinic. Long prismatic crystals, earthy, incrustations. Cleavage perfect clinopinacoidal. Color generally sky-blue or green, rarely colorless. Pearly to dull luster. H=1.5—2; G=2.58—2.68.

The iron phosphate is formed in rocks, usually sedimentary rocks, by decaying phosphatic matter such as bones, in the presence of iron.

Alameda County: Small specimens of earthy blue vivianite were found some years ago in the hills back of Berkeley and were reported by Hanks[6].

Calaveras County: Has been found at Copperopolis.

Humboldt County: Occurs in the rock at Yager.

Los Angeles County: Early observed as earthy blue masses in the asphalt bed of the Rancho de la Brea, where it formed by the decomposition of the bones of extinct animals. Mentioned by W. P. Blake[15].

Madera County: Dark blue earthy masses have been found near Raymond.

Yuba County: Good crystals occurred near Camptonville and were described by Jackson[3]. They showed the forms: (010), (100), (110), (111), (101), (411), (410).

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247. PURPURITE.

Hydrous phosphate of manganese and iron $(Fe,Mn)_2O_3.P_2O_5.H_2O$.

Orthorhombic. Irregular masses. Color deep red or purple. Satin luster. H=4—4.5; G=3.40.

One of the very rare minerals associated with the pegmatites of San Diego County. Of a deep red or purple color.

San Diego County: Found at Pala in a pegmatitic dike on Hiriart Hill, associated with lithiophilite and triphylite, Graton and Schaller[1].

248. TURQUOIS.

Hydrous phosphate of aluminium, $AlPO_4.Al(OH)_3.H_2O$.

Massive. In thin seams and incrustations. Color sky-blue, bluish green, apple-green. Waxy luster. H=6; G=2.6—2.83.

Thin seams of apple-green and bluish green turquois occur in the State which are suitable for gem purposes when cut with the matrix.

Fresno County: A specimen of turquois (Kallaite) was found on the Taylor ranch, having a hexagonal form and it was described as a pseudomorph after apatite, Moore and Zepharovitch[1].

San Bernardino County: Some apple-green turquois has been found near Victor. Turquois was early mined from a deposit in the extreme northeastern part of the county in the high mountains north of Ivanpah. Considerable light green gem material has been obtained from this district.

249. PLUMBOGUMMITE.

Hydrous phosphate of lead and aluminium, $PbO.2Al_2O_3.P_2O_5.\ H_2O$.

Hexagonal. Globular, incrustations, compact massive. Color reddish brown, yellowish gray. Resinous luster. H=4—5; G=4—4.9.

Inyo County: A specimen of this rare mineral has been found at the Cerro Gordo mine.

250. HUREAULITE.

Hydrous phosphate of manganese, $5MnO.2P_2O_5.5H_2O$.

Monoclinic. Groups of short prisms. Also scaly, massive. Color orange-red, rose and nearly colorless. H=5; G=3.185.

San Diego County: Found in the Stewart mine at Pala and mentioned by Schaller[14].

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251. PALAITE.

Hydrous phosphate of manganese, $5MnO.2P_2O_5.4H_2O$.

Monoclinic? Crystalline masses. Color flesh-red. G=3.14—3.20.

San Diego County: A new phosphate of manganese having a flesh-red color, which has resulted from the alteration of lithiophilite. Found in the Stewart mine at Pala and described and analysed by Schaller[14]. Analysis:

FeO	MnO	CaO	Fe_2O_3	P_2O_5	H_2O	Li_2O	Insol.	
7.48	40.87	1.77	0.16	39.02	10.43	tr.	0.89	=100.62%

252. STEWARTITE.

Hydrous phosphate of manganese.

Triclinic? Minute crystals. G=2.94.

San Diego County: Found in the Stewart mine at Pala as an abundant alteration product of lithiophilite. Finely fibrous doubly refracting mineral probably triclinic. Described by Schaller[14].

253. SALMONSITE.

Hydrous phosphate of manganese and iron, $Fe_2O_3.9MnO.4P_2O_5.14H_2O$.

Massive. Color buff-yellow. G=2.88.

San Diego County: A new mineral resulting from the alteration of hureaulite, having a buff-yellow color, occurring in the Stewart mine associated with fibrous palaite and blue strengite. Described and analysed by Schaller[14]. Analysis:

FeO	MnO	CaO	Fe_2O_3	P_2O_5	H_2O	Insol.	
0.13	37.74	1.06	9.53	34.86	15.73	1.40	=100.45%

254. STRENGITE.

Hydrous phosphate of iron. $Fe_2O_3.P_2O_5.4H_2O$.

Orthorhombic. Generally in spherical and botryoidal forms. Color pale red. Vitreous luster. H=3—4; G=2.87.

San Diego County: Found in the Stewart mine at Pala associated with salmonsite, Schaller[14].

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255. SICKLERITE.

Hydrous phosphate of iron, manganese and lithia, $Fe_2O_3.6MnO.4P_2O_5.3(Li,H)_2O$.

Massive. Color dark brown. Streak light yellowish brown. G=3.45.

San Diego County: Occurs in cleavable masses at the Vanderburg-Naylor mine on Hiriart Hill, near Pala. Dark brown mineral resulting from the alteration of lithiophilite. Described and analysed by Schaller[14]. Analysis:

MnO	CaO	Fe_2O_3	Mn_2O_3	P_2O_5	H_2O	Li_2O	Insol.	
33.60	0.20	11.26	2.10	43.10	1.71	3.80	4.18	=99.95%

256. WILKEITE.

Phosphate and silico-sulphate of calcium, $3Ca_3(PO_4)_2.CaCO_3+3Ca_3(SiO_4)(SO_4).CaO$.

Hexagonal. Small prismatic crystals and grains. Color pale rose-red. Vitreous luster. H=5; G=3.234.

This very rare mineral is unlike any other in having four acid radicals. It resembles apatite in physical properties.

Riverside County: The most recently discovered new mineral in the State, occurring in blue calcite, with diopside, vesuvianite, garnet and its alteration product, okenite, at the limestone quarry at Crestmore. Analysis by Eakle and Rogers[1].

CaO	MnO	P_2O_5	SO_3	SiO_2	CO_2	H_2O	
54.44	0.77	20.85	12.28	9.63	2.10	tr.	=100.06%

VANADATES.

The minerals containing vanadium are exceedingly rare and are only represented by a few specimens.

257. PUCHERITE.

Vanadate of bismuth, $BiVO_4$.

Orthorhombic. Tabular and acicular crystals. Perfect basal cleavage. Color reddish brown. Streak yellow. H=4; G=6.25.

San Diego County: The yellow bismuth ocher which occurs at the Pala Chief mine, near Pala, has been determined by Schaller[9] to be pucherite, with the following composition:

			H_2O			
Bi_2O_3	V_2O_5	Insol.	at 107°	at 240°	Ign.	
66.14	25.80	7.37	0.21	0.32	0.84	=100.68%

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258. VANADINITE.

Vanadate of lead with chlorine $(PbCl)Pb_4(VO_4)_3$.

Hexagonal. Small prisms. Color deep ruby-red, sometimes yellow. Somewhat resinous luster. H=3; G=6.66 — 7.23.

San Bernardino County: This rare lead mineral occurs at Camp Signal associated with cerussite and cuprodescloizite, Schaller[12].

259. DESCLOIZITE—Cuprodescloizite.

Vanadate of lead, zinc and copper.

Orthorhombic. Drusy surfaces and crusts. Color yellowish brown, dull green and greenish black. H=3.5; G=6.2.

San Bernardino County: Minute colorless and yellowish plates of the rare cuprodescloizite occur with cerussite and vanadinite at Camp Signal, Schaller[12].

260. VOLBORTHITE.

Hydrous vanadate of copper, barium and calcium.

Small plates in globular aggregations. Color olive-green, citron-yellow. Streak yellowish green. Pearly to vitreous luster. H=3 — 3.5; G=3.5.

Glenn County: Reported to have been found at the Mammoth Copper mine on Grindstone Creek.

ARSENATES AND ANTIMONATES.

These two classes of minerals are generally the result of the direct oxidation and hydration of arsenides and the sulphosalts of arsenic and antimony. They are usually found as coatings upon the mineral from which they are derived.

261. MIMETITE.

Arsenate of lead with chlorine $(PbCl)Pb_4(AsO_4)_3$.

Hexagonal. Prismatic crystals, rounded or globular aggregations. Color pale yellow, light brown. Resinous luster. H=3.5; G=7 — 7.25.

Brown crystals of mimetite are often associated with pyromorphite, and the two minerals are very closely allied in properties and occurrences.

Inyo County: One of the numerous minerals occurring in the Cerro Gordo mines.

San Bernardino County: Small amounts of the mineral were found in the Morning Star mine, Lava Beds district.

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262. ERYTHRITE—Cobalt Bloom.

Hydrous arsenate of cobalt, $Co_3As_2O_8.8H_2O$.

Monoclinic. Fibrous, incrustations, earthy. Cleavage perfect clinopinacoidal. Color peach-blossom red. Pearly to adamantine luster. H=1.5 — 2.5; G=2.95.

The peach-blossom red coatings and incrustations of erythrite are seen wherever smaltite or other cobalt minerals exist, and this secondary oxidation product often serves to locate deposits of cobalt.

Los Angeles County: Coatings of erythrite with smaltite, argentite and barite occurred at the old Kelsey and O. K. mines of the San Gabriel Canyon.

Mariposa County: Found in rock seams with danaite, the cobaltiferous arsenopyrite, at the Josephine mine, Bear Valley, Turner[4].

Napa County: Occurs with smaltite in serpentine and chlorite in the Beryessa Valley.

263. ANNABERGITE—Nickel Bloom.

Hydrous arsenate of nickel, $Ni_3As_2O_8.8H_2O$.

Monoclinic. Finely fibrous incrustations. Color apple-green. Vitreous luster. Very soft.

The green coatings of this nickel compound are an indication of the presence of nickel minerals that have been oxidized, and often the cobalt bloom is associated with the nickel bloom.

Lassen County: Reported with erythrite and smaltite from this county.

Los Angeles County: The green coatings of nickel arsenate were associated with erythrite and smaltite at the Kelsey mine, San Gabriel Canyon, Storms[1].

Tulare County: The green color of the chrysoprase and chrysopal in the hills east of Porterville is due to nickel, and some coatings of annabergite occur in the region.

264. SCORODITE.

Hydrous arsenate of iron, $FeAsO_4.2H_2O$.

Orthorhombic. Aggregates of small crystals. Color pale leek-green, liver-brown. H=3.5 — 4; G=3.1 — 3.3.

Mariposa County: Pale green crystals of scorodite were found as an alteration product of arsenopyrite associated with pitticite on the South Merced River, near the mouth of Devil's Gulch, Rogers[5].

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265. LIROCONITE.

Hydrous arsenate of aluminium and copper.

Monoclinic. Thin tabular crystals. Color sky-blue, green. Streak blue or green. Vitreous luster. H=2 — 2.5; G=2.88 — 2.98.

Inyo County: The very rare copper arsenate was found at the old Cerro Gordo mine associated with other rare copper salts.

266. PITTICITE.

Hydrated arsenate and sulphate of iron.

Massive and reniform. Color brown. H=2 — 3; G=2.2 — 2.5.

Mariposa County: Dark brown amorphous pitticite resembling limonite was found with scorodite as an alteration product of arsenopyrite, on the South Merced River, near the mouth of Devil's Gulch, Rogers[5].

267. BINDHEIMITE.

Hydrous antimonate of lead, $Pb_3Sb_2O_8.4H_2O$.

Amorphous. Lamellar, massive, incrustations. Color brown, white, gray. Resinous luster. H=4; G=4.6 — 4.76.

Inyo County: Brown resinous lead antimonate was one of the rare minerals at the Union and Modoc mines, and was mentioned by W. P. Blake[6].

NITRATES.

The nitrates can only exist in solid form in arid regions and are therefore peculiar to desert lands where they are sometimes left as white incrustations by evaporation. Some of these white crusts are to be found in the California desert land, but no important deposits are known.

268. SODA NITER—Chili Saltpeter.

Nitrate of sodium, $NaNO_3$.

Hexagonal, rhombohedral. Crystals, massive, incrustations. Cleavage perfect rhombohedral. Color white, reddish, yellowish. Vitreous luster. H=1.5 — 2; G=2.24 — 2.29.

Inyo County: Crusts of saltpeter occur along the Amargosa River and along shore lines and old beaches of Death Valley, which were reported by Bailey[1].

San Bernardino County: The same white incrustations extend along the Amargosa River in this county. Small amounts of soda niter have been found in the Calico district, Williams[1] and at Searles Borax Lake.

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269. NITER—Saltpeter.

Nitrate of potassium, KNO_3.

Orthorhombic. Silky tufts, incrustations. Color white. Vitreous luster. H=2; G=2.09—2.14. Salt taste.

Inyo County: The common saltpeter occurs with the soda niter in the Death Valley region.

Riverside County: Bailey[1] mentions saltpeter as found in the desert northeast of Salton.

San Bernardino County: Occurs with the soda niter in the Amargosa Canyon.

270. NITROCALCITE.

Hydrous nitrate of calcium, $Ca(NO_3)_2.n\ H_2O$.

Silky tufts and masses. Efflorescent. Color white or gray. Sharp, bitter taste.

San Bernardino County: The white efflorescent nitrocalcite occurs in the niter beds of the lower end of Death Valley, according to Bailey[1].

271. DARAPSKITE.

Hydrous sulphato-nitrate of sodium, $NaNO_3.Na_2SO_4.H_2O$.

Tetragonal. Square tabular crystals. Colorless.

San Bernardino County: This rare nitrate occurs in the niter beds of Death Valley according to Bailey[1].

272. NITROGLAUBERITE.

Hydrous sulphato-nitrate of sodium, $6NaNO_3.2Na_2SO_4.3H_2O$.

Fibrous masses. Color white.

Inyo County: Also an efflorescence in the niter beds of Death Valley, according to the report of Bailey[1].

BORATES.

The element boron is widely distributed in the State. It is present in many of the spring waters and lakes and has been an important factor in the formation of much of the igneous rocks of the Sierras. Granites and acid pegmatites containing an abundance of tourmaline are very common. The bedded deposits of lime and soda borates in the

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southern counties appear inexhaustible. All of the deposits of borates occur in regions which have been the scene of much volcanic activity, and the emanations of the boron gas have accompanied or followed eruptions and intrusions, issuing from vents in the form of hot borated waters. It is by the action of these waters on the travertine or soda accumulations in lake depressions that the thick bedded deposits of these borate salts have formed.

273. LUDWIGITE.

Borate of magnesia and iron, $3MgO.B_2O_3.FeOFe_2O_3$.

Orthorhombic. Small fibrous masses. Color blackish green. Silky luster. H=5; G=3.91 — 4.02.

El Dorado County: Scaly masses of black ludwigite, associated with calcite, epidote, molybdenite and chalcopyrite occur at the old Cosumnes copper mine, near Fairplay, Rogers[5].

274. BORAX—Tincal.

Hydrous borate of sodium, $Na_2B_4O_7.10H_2O$.

Monoclinic. Crystals, powder, incrustations. Colorless, white. Greasy to dull luster. H=2 — 2.5; G=1.69 — 1.72. Sweetish alkaline taste.

The natural borax usually accompanied by sulphates of lime and soda, is common at many of the depressions or sinks of the deserts. For some time it was the chief mineral, but the more extensive solid masses of colemanite have replaced it as the principal boron mineral.

Tincalconite. A name given to a white efflorescent variety by Shepard[2].

Inyo County: The borax industry began with the discovery of the extensive deposits of Death Valley, although some borax had been previously dredged from Little Borax Lake, in Lake County. The mines on Furnace Creek and at Resting Springs produced large quantities, and it was hauled to Mojave by the famous 20-mule team.

Kern County: Borax is also common at some of the sinks and wells of the desert and has been obtained from Cane Springs and Desert Wells.

Lake County: The first discovery of borax in the State was made at Little Borax Lake, a few miles south of Clear Lake. Fine large crystals were obtained from the mud of the lake bottom, and considerable borax was dredged from this lake before the more important deposits of San Bernardino were discovered. W. P. Blake[8] and Hanks[5] have described this occurrence.

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Riverside County: Incrustations of borax are rather common at some of the playa or dry lakes of this county, but none is produced.

San Bernardino County: The most important deposit of natural borax in the State occurs at Searles Borax Lake in the northern part of the county. Hanks[9] and others have described this deposit. It consists of a pan-like depression about 10 miles long by 5 miles wide and borax occurs with numerous other salts deposited by the evaporated waters of the lake. The associated minerals forming layers in the deposit are mainly sulphates and carbonates of sodium and it is now mainly for these that the deposit is worked. This locality is noted for the great variety of interesting salts that have formed by the evaporation of the waters.

Borax also occurs at Borate and at many of the numerous depressions in the Mojave desert and in the lower end of Death Valley.

275. COLEMANITE.

Hydrous borate of calcium, $Ca_2B_6O_{11}.5H_2O$.

Monoclinic. Crystals, massive. Cleavage perfect clinopinacoidal. Colorless, white, yellowish-white. Vitreous luster. H=4 — 4.5; G=2.42.

This valuable borate is the principal mineral for borax in the State. It was first discovered in Death Valley in 1882 and in the following spring at Borate in what is known as the Calico district.

Priceite is a massive chalk-like variety.

Pandermite is a compact variety occurring with priceite.

Neocolemanite is a variety showing slight optical differences.

Inyo County: The deposits of Death Valley occur on the east fork of the Black Mountains of the Amargosa Range near its southern end, and immense solid veins or beds of the mineral occur. The important mine is the Lila C., at Ryan, which has been described by Gale[1]. The mineral was first analysed by Price[1] with the results shown in analysis No. 1. Analyses 2, 3 and 4 are by Whitfield[1].

	B_2O_3	CaO	Al_2O_3	Fe_2O_3	MgO	SiO_2	H_2O	
1.	(48.12)	28.43	0.60		--	0.65	22.20	
2.	50.70	27.31			0.10	--	21.87	= 99.98%
3.	49.56	27.36			0.25	0.44	22.66	=100.27
4.	49.62	27.40			0.26	0.47	22.70	=100.45

Priceite has been found as pseudomorphs after ulexite in Death Valley.

Los Angeles County: An important and extensive deposit occurs near Lang which Eakle[8] describes as a variety and calls neocolemanite. Hutchinson[1] shows it to be identical with colemanite. It occurs as thin and thick seams, almost vertical, and has considerable howlite associated with it. The mineral has been described and analysed by

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Eakle. Forms: (001), (010), (100), (210), (110), (230), (011), (021), ($\bar{2}$01), ($\bar{3}$01), (241), (231), (221), ($\bar{6}$61), ($\bar{2}$21), ($\bar{2}$23), ($\bar{2}$11), ($\bar{2}$63).

B_2O_3	CaO	H_2O		
49.45	27.76	22.48	=99.69%	Sp. G.=2.423° at 13° C.

San Bernardino County: The extensive deposit of colemanite at Borate, in the Calico district, near Daggett, was discovered in the spring of 1883 and became the principal source of the mineral, but the works are now abandoned. Beautiful crystals of the mineral in large geodal masses occurred having celestite crystals associated with them. The crystals were first described by Jackson[1][2][3]. Forms: (001), (010), (100), (210), (110), (120), (130), (370), (10.19.0), (011), (021), (201), (101), ($\bar{1}$01), ($\bar{2}$01), ($\bar{3}$01), ($\bar{4}$01), ($\bar{6}$01), (111), (311), (711), (10.1.1), (771), (19.19.6), (331), (731), (131), (121), ($\bar{1}$11), ($\bar{2}$21), ($\bar{3}$31), ($\bar{4}$11), ($\bar{3}$11), ($\bar{2}$11), ($\bar{7}$21), ($\bar{3}$21), ($\bar{2}$31), ($\bar{1}$21), ($\bar{2}$41), ($\bar{1}$31), ($\bar{2}$32), ($\bar{4}$12). Additional forms described by Eakle[2] are: (310), (301), ($\bar{5}$02), ($\bar{8}$01), (522), (142), (141), (164), (165), (232), ($\bar{1}$23), ($\bar{1}$82), ($\bar{3}$41).

Analysis No. 1 is by Hiortdahl[1] and No. 2 by Bodewig[1].

	B_2O_3	CaO	Al_2O_3	Fe_2O_3	MgO	SiO_2	H_2O	
1.	47.64	27.97	0.19		0.13	1.28	22.79	
2.	49.70	27.42	--	--	--	--	22.26	=99.38%

Small amounts of colemanite were found with borax at Searles Borax Lake, Hanks[10]. Some priceite and pandermite accompanied the colemanite of Calico.

Ventura County: Deposits of colemanite similar to the Lang deposit exist in the Frazer Mountains and have been mined for some years. These deposits have been described by Gale[3].

References to literature on colemanite: Evans[1][2], Jackson[1][2][3], Hiortdahl[1], Arzruni[1], Bodewig and von Rath[1], Mulheims[1], Baumhauer[1] and Eakle[2][8]. Campbell[1][2]. Gale [1][2][3].

276. ULEXITE—Cotton-balls.

Hydrous borate of sodium and calcium, $NaCaB_5O_9.8H_2O$.

Usually in nodules or sheets of fine fibers. Color white. Silky luster. Very soft. G=1.65.

The white silky balls of ulexite are frequently found at some of the desert depressions, often with borax.

Inyo County: Ulexite masses are found at some of the sinks in the Death Valley.

Kern County: Ulexite was mentioned from the Cane Spring District by Silliman[8]. Found in quantity in the bed of an extensive salt marsh a few miles north of Desert Wells, W. P. Blake[16].

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Los Angeles County: Found in compact masses at Lang with colemanite.

San Bernardino County: Found at Borate and in the lower part of Death Valley. It has also been found in several places in the Mojave Desert.

277. HYDROBORACITE.

Hydrous borate of calcium and magnesium, $CaMgB_6O_{11}.6H_2O$.

Monoclinic. Fibrous masses. Color white with red spots. H=2; G=1.9—2.

San Bernardino County: Found with colemanite at Calico but in subordinate amounts.

Ventura County: Said to occur at the colemanite mines of Frazer Mountains.

278. BAKERITE.

Hydrous silico-borate of calcium, $8CaO.5B_2O_3.6SiO_2.6H_2O$.

Amorphous. Massive. Color white to faint green. H=4.5; G=2.73.

San Bernardino County: This new borate was found in the Mojave Desert, about sixteen miles northeast of Daggett, associated with howlite and ulexite. Described and named by Giles[1].

	B_2O_3	CaO	SiO_2	H_2O	$Al_2O_3Fe_2O_3$
White	27.74	34.88	28.45	8.30	0.63
Faint green	26.85	35.22	28.05	8.66	0.22

279. HOWLITE.

Hydrous silico-borate of calcium, $H_5Ca_2B_5SiO_{14}$.

Orthorhombic? Round nodules, massive, chalky. Color white. Dull luster. H=1—3.5; G=2.5.

Howlite is an associate of the other borates, but owing to the silica present it is not utilized, although it contains a large amount of boric oxide.

Los Angeles County: Large masses of compact white howlite are common in the colemanite deposit near Lang, and the mineral has been described and analysed by Eakle[8].

B_2O_3	CaO	SiO_2	H_2O	
45.56	28.26	14.81	11.37	=100.38%

San Bernardino County: Large masses occur associated with bakerite and ulexite in the Mojave Desert, sixteen miles northeast of Daggett,

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Giles[1]. Analyses No. 1 is of soft scaly, and No. 2 of hard rock-like material made by Giles. Analysis No. 3 is of soft white material, made by Wm. Lawson.

	B_2O_3	CaO	SiO_2	H_2O	$MgONa_2O$	
1.	44.38	28.45	15.50	11.58	0.09	
2.	43.78	28.44	15.33	11.39	1.06	
3.	44.32	29.22	15.31	11.44	--	=100.29%

NIOBATES-TANTALATES.

The niobate-tantalate group of minerals are characteristic of acid pegmatite veins. They are mostly of high specific gravity, varying in color from yellow to brown and black, and often containing the rare earth oxides.

280. PYROCHLORE.

Niobate of titanium, calcium, cerium and thorium.

Isometric. Commonly in octahedrons. Color dark reddish brown. Streak light yellowish brown. H=5 — 5.5; G=4.32.

San Diego County: A dark brown isotropic mineral, presumably pyrochlore, surrounded by microlite, came from some locality in the county, Rogers[5].

281. MICROLITE.

Tantalate of calcium, $Ca_2Ta_2O_7$

Isometric. Often small octahedrons. Color pale yellow to brown. Luster resinous. H=5.5; G=5.48.

San Diego County: This rare tantalate has been found in the county, exact locality unknown, as a honey-yellow mineral associated with albite, lepidolite, tourmaline and colorless apatite. A few crystals are octahedral with narrow faces of (011) and (311), Rogers[5].

282. COLUMBITE—TANTALITE.

Niobate of iron and manganese $(Fe,Mn)Nb_2O_6$.

Orthorhombic. Prismatic crystals, massive. Color iron-black, brownish black. Submetallic luster. Streak dark brown to black. H=6; G=5.3 — 7.3.

Fresno County: Massive and crystalline black columbite has been found at the Reynolds mine, Kings River district.

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San Diego County: Crystals from the Little Three mine, near Ramona, were described by Eakle[6]. Forms: (100), (010), (110), (130), (150), (160), (021), (111), (221), (211), (121), (131), (141). Small imperfect crystals found at the Victor mine, Rincon, have the forms (100), (210), (130), (103), (133), Rogers[3].

283. STIBIOTANTALITE.

Niobate and tantalate of antimony, $m\,(SbO)_2Nb_2O_6.n\,(SbO)_2Ta_2O_6$.

Orthorhombic. Hemimorphic prisms, twinned. Color light brown to dark brown. Resinous to adamantine luster. H=5—5.5; G=5.98—7.37, mostly 6.6—6.7. Pyroelectric.

San Diego County: This rare mineral was found in small amounts in the pegmatite veins at Mesa Grande associated with gem tourmaline, pink beryl, quartz, orthoclase, lepidolite and cassiterite. It was described and analysed by Penfield and Ford[1]. Forms: (100), (110), (130), (209), (203), (4.12.9), (043), (100), (110), (130), (209), (203), (4.12.9). The analyses show a varying amount of niobium and tantalium to antimony.

$(Nb,Ta)_2O_5$	Sb_2O_3	Bi_2O_3		
55.33	44.26	0.33	= 99.92%	Sp.G.=6.72
50.30	49.28	0.53	=100.11	Sp.G.=5.98

$(Nb,Ta)_2O_5$		Nb_2O_5	Ta_2O_5
55.33	=	18.98	36.35%
50.30	=	39.14	11.16%

TUNGSTATES AND MOLYBDATES.

The three valuable tungsten minerals, scheelite, wolframite and hübnerite, have been found in several localities in the State, but only scheelite has until lately been worked for tungsten. The manganese tungstate, hübnerite, usually contains iron and grades into the iron-manganese tungstate, wolframite. Wulfenite is the common and only molybdate known in the State.

284. WOLFRAMITE—HÜBNERITE.

Tungstate of manganese and iron $(Mn,Fe)WO_4$.

Monoclinic. Thick tabular crystals and massive. Perfect clinopinacoidal cleavage. Color dark grayish or brownish black, brownish red. Thin splinters often deep red. Streak dark brown to black. Luster metallic to submetallic. H=5—5.5; G=7.2—7.5.

Inyo County: Boulders of black wolframite have been found in Death Valley.

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Madera County: Large crystals and masses weighing several pounds occur in quartz, about twelve miles north of Raymond. The quartz vein with the wolframite is in an andalusite schist.

Mariposa County: Crystals and massive wolframite have been found near Buchanan.

San Bernardino County: Veins of wolframite with some scheelite have been located in the Clark Mountains.

285. SCHEELITE.

Tungstate of calcium, $CaWO_4$.

Tetragonal. Pyramidal crystals and massive. Color white, yellow, brown. Vitreous luster. H=4.5 — 5; G=5.9 — 6.1.

Scheelite is the principal tungsten mineral of the State and important deposits exist. It is frequently found in isolated crystals and patches in quartz-feldspar veins and has been reported from several localities.

Kern County: Small amounts of scheelite occur in the Amalie district.

Nevada County: A few brownish yellow masses were found in a quartz ledge at Howard Hill, Grass Valley, Hanks[6]. Small amounts of reddish brown scheelite occurred at the 3,000-foot level of the Empire mine, Grass Valley. Veins of white scheelite intermixed with quartz and feldspar occur at the Union Hill mine, Grass Valley, and is mined.

San Bernardino County: The most important veins of scheelite occur at Atolia in the Papoose and other claims. The scheelite occurs in a quartz-feldspar vein, and is generally intimately mixed with the gangue, forming a low grade ore. Some scheelite is associated with wolframite in Clark Mountain.

San Diego County: Massive brown scheelite has been found at Julian.

Siskiyou County: Scheelite in crystals has been observed at Scott Bar.

Tulare County: Small amounts of yellow scheelite have come from a locality east of Visalia.

286. CUPROSCHEELITE—Cuprotungstite.

Tungstate of copper and calcium $(Ca,Cu)WO_4$.

Granular, incrustations. Color olive-green, pistachio-green. Vitreous luster. H=4.5 — 5.

Kern County: Reported to have been found with radiating black tourmaline at the Green Monster mine, twelve miles east of White River, Hanks[1].

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287. WULFENITE.

Molybdate of lead, $PbMoO_4$.

Tetragonal. Thin tabular crystals; sometimes pyramidal. Color orange-yellow, bright red. Adamantine luster. H=2.5—3; G=6.7—7.

Inyo County: Crystals of wulfenite occurred with the linarite and caledonite of the Cerro Gordo mine.

Kern County: Wulfenite was found six miles northeast of Cane Springs, Hanks[6].

Plumas County: Found at the Diadem Lode on Mumford Hill.

San Bernardino County: Considerable wulfenite was found with the lead carbonate of the Silver Reef district, Storms[1].

San Luis Obispo County: Found at the Fairview mine.

URANATES.

The uranium minerals are very rare and only one or two specimens of them have been found in California. All uranates are highly radioactive and pitchblende forms the ore of radium, so it is a very valuable mineral.

288. URANINITE—Pitchblende.

Uranate of uranyl, lead and the rare earths.

Isometric. Crystals rare. Generally massive and granular. Color grayish to brownish black. Streak brownish black or greenish. Submetallic to pitch-like luster. H=5.5; G=9—9.7.

Calaveras County: The only known occurrence of the heavy brown pitchblende was at the Rathgeb mine, near San Andreas, where it was found in acicular crystals in a pocket with spongy gold, quartz and clay, Rickard[1].

289. URACONITE—Uranocher.

Hydrous uranate or sulphato-uranate.

Amorphous, earthy or scaly. Color lemon-yellow.

Calaveras County: This occurs as an alteration product of pitchblende at the Ratgeb mine, in coatings immediately in contact with the gold, Rickard[1].

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CHAPTER XI.

SULPHATES.

Anhydrous.
Mascagnite
Thenardite
Arcanite
Glauberite
Barite
Celestite
Anglesite
Anhydrite
Sulfohalite
Hanksite
Leadhillite
Caledonite
Brochantite
Linarite

Hydrous.
Mirabilite
Gypsum
Epsomite
Morenosite
Melanterite
Pisanite
Boothite
Chalcanthite
Blödite
Boussingaultite
Kalinite
Tschermigite
Halotrichite

Sonomaite
Coquimbite
Alunogen
Copiapite
Knoxvillite
Redingtonite
Botryogen
Alunite
Jarosite

HYDROCARBONS.

Napalite
Ionite
Aragotite
Posepnyte
Bernardinite

Petroleum
Bitumen
Asphalt
Gilsonite
Coal

290. MASCAGNITE.

Sulphate of ammonium $(NH_4)_2SO_4$.

Orthorhombic. Generally in mealy crusts. Color lemon-yellow, yellowish gray. Vitreous to dull luster. H=2 — 2.5; G=1.76 — 1.77. Bitter taste.

Sonoma County: Goldsmith[1] reported finding mascagnite with boussingaultite in this county but the locality was not given.

291. THENARDITE.

Sulphate of sodium, Na_2SO_4.

Orthorhombic. Pyramidal crystals. Color white. Vitreous luster. H=2.68 — 3; G=2.68 — 2.69.

Inyo County: White masses of sodium sulphate occur in the Funeral Range and in the dry depressions of Death Valley.

San Bernardino County: Thenardite forms layers several feet in thickness at the Searles Borax Lake. Large crystals of it occur often as cruciform twins. The crystals were described by Ayers[1]. Forms: (110), (001), (111), (106), (100).

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San Luis Obispo County: Soda Lake on the Carissa Plains, a depression between the Caliente and Tremblor ranges, is a dry lake with crusts of sodium sulphate. Analysis of this crust by Steiger gave:

Insol.	Al_2O_3	MgO	CaO	Na_2O	K_2O	H_2O	SO_3	Cl		O	
0.40	0.04	1.66	0.45	40.50	0.28	3.65	46.12	9.27	=102.37%	— 2.09	=100.28

292. ARCANITE.

Sulphate of potassium, K_2SO_4.

Orthorhombic. Thin basal plates. Colorless, yellowish. Vitreous luster. H=2.

Orange County: Found as thin crystals in a mine-timber in Tunnel No. 1 of the Santa Ana Tin Mining Company in Trabuca Canyon. The crystals are twinned on the prism and have the forms: (001), (111), (112), (102), Eakle[7].

293. GLAUBERITE.

Sulphate of sodium and calcium, $Na_2SO_4.CaSO_4$.

Monoclinic. Tabular crystals. Cleavage perfect basal. Color yellowish white or gray. Vitreous luster. H=2.5 — 3; G=2.7 — 2.85.

San Bernardino County: The double salt of soda and lime is also a very prominent mineral in the deposit at Searles Borax Lake. It is found in platy crystals with the forms: (001), (111), vom Rath[1].

294. BARITE—Heavy Spar.

Sulphate of barium, $BaSO_4$.

Orthorhombic. Tabular and prismatic crystals, massive, lamellar; granular, concretionary. Cleavage perfect basal and good prismatic. Color white, yellow, brown. Vitreous luster. H=2.5 — 3.5; G=4.3 — 4.6.

Barium sulphate is one of the common minerals of the State and some deposits of it occur. It is commonly found as a gangue mineral in vein deposits, and is especially associated with galena, and therefore prominent in silver-lead districts.

Alpine County: Found with pyrite and enargite at the Morning Star mine.

Butte County: With gold at the Pinkstown ledge, Big Bend Mountain, Turner[1].

Calaveras County: Occurs on Carson Hill with quartz and gold. Also with the pyrite at Copperopolis and at Campo Seco.

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El Dorado County: Yellow platy barite occurs on Slate Mountain and ten miles above Georgetown.

Fresno County: Nodules and large concretions of dark gray impure barite occur in the Mount Diablo Range.

Inyo County: Massive barite occurs near Independence; at the Defiance mine with native sulphur; white massive at Bishops Creek, White Mountains; veins in the Alabama Range.

Kern County: Nodular masses in the Mount Diablo Range.

Los Angeles County: White barite occurs near Azusa. Barite was a gangue mineral in the old Kelsey mine, San Gabriel Canyon, Storms[1].

Mariposa County: A large deposit of barite occurs about two miles west of El Portal which has produced much of the mineral mined in the State.

Mono County: Barite has been found as a gangue mineral near Bodie, Benton and other mining districts.

Napa County: Plates of barite occur at the Manhattan mine, Knoxville, with cinnabar; platy quartz as pseudomorphs after barite also are common at this mine.

Nevada County: Occurs with gold at the Malakoff mine, North Bloomfield. Slender prisms of barite in a limonite gangue associated with gold occur at Pine Hill and these crystals have been described by Eakle[6]. Forms: (100), (010), (110), (210), (320), (530), (130), (001), (102), (011), (111), (113).

Orange County: A white barite gangue occurred with the tiemannite of San Joaquin Ranch mine.

Placer County: White barite comes from near Lincoln.

Plumas County: Found associated with lead and copper minerals in Indian Valley.

San Bernardino County: Barite was common as a gangue in the silver district of Calico and Bismark, occurring as white and yellow platy masses, Lindgren[1], Storms[1]. Also common at the Imperial mine.

San Francisco County: Needles of barite have been found at Fort Point.

San Mateo County: Massive barite has been found on Permenente Creek.

Santa Barbara County: White massive at Santa Maria.

Shasta County: Barite occurs at several of the copper mines as a gangue mineral but the amount is small.

Siskiyou County: Found with argentiferous galena about 2½ miles north of Callahan.

Trinity County: Dark gray barite occurs about fifteen miles below Hayfork.

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295. CELESTITE.

Sulphate of strontium, $SrSO_4$.

Orthorhombic. Crystals and massive. Cleavage perfect basal. Colorless, pale bluish. Vitreous luster. H=3—3.5; G=3.95—3.97.

Inyo County: Slender bluish crystals occur with the colemanite of Death Valley and these have been measured by Eakle[7]. Forms: (001), (110), (102), (104), (011), (122), (067).

San Bernardino County: Long crystals occur with the colemanite of Calico similar to those from Death Valley. Celestite was reported as one of the associated minerals of Searles Borax Lake by Hanks[9].

296. ANGLESITE.

Sulphate of lead, $PbSO_4$.

Orthorhombic. Prismatic crystals and massive. Colorless, white, yellow, gray, brown. Adamantine luster. H=2.5—3; G=6.12—6.39.

The sulphate of lead is a very common oxidation product of galena, consequently it is often found in lead districts usually in small amounts.

Inyo County: Considerable anglesite has been formed from the lead sulphides in the Cerro Gordo district. Found associated with bindheimite, galena and linarite at the Modoc mine; gray masses banded with cerussite occur at the Cerro Gordo mine. Good crystals associated with linarite and caledonite have come from this mine, with the forms: (001), (100), (110), (104), (111), (122), Eakle[7].

Mono County: Anglesite occurs with galena in the Benton district.

297. ANHYDRITE.

Sulphate of calcium, $CaSO_4$.

Orthorhombic. Generally granular or lamellar massive. Color white, bluish white. Vitreous luster. H=3—3.5; G=2.89—2.98.

Inyo County: Found massive at the St. Ignacio and Cerro Gordo mines.

Mono County: Associated with barite at the Mammoth mine, Mineral Hill.

Orange County: Found in the Santa Ana Mountains, near Anaheim, Hanks[6].

San Bernardino County: Anhydrite is mentioned as one of the associated minerals at Searles Borax Lake, Hanks[9].

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298. SULFOHALITE.

Chloro-sulphate of sodium, $3Na_2SO_4.2NaCl$.

Isometric. Rhombic dodecahedrons with cubes and tetrahedrons. Color faint greenish yellow. Vitreous luster. H=3.5; G=2.489.

San Bernardino County: Found as small crystals implanted on hanksite, at Searles Borax Lake, and was described as a new mineral and named by Hidden and Mackintosh[1][2]. Forms: (111), (101), (100).

SO_3	Cl	Na_2CO_3		Na_2SO_4	NaCl	Na_2CO_3		
42.48	13.12	1.77	=	75.41	21.62	1.77	=98.80%	Sp.G=2.489

299. HANKSITE.

Carbonato-sulphate of sodium, $4Na_2SO_4.Na_2CO_3$.

Hexagonol. Prismatic, tabular. Color white. Vitreous luster. H=3—3.5; G=2.562. Taste saline.

The double soda salt is quite common in the borax lake districts where it has crystallized in large hexagonal crystals. It was discovered as a new mineral in 1885 and its occurrence is practically limited to this State.

Inyo County: Some hanksite is found with the borax in the sinks of Death Valley.

San Bernardino County: First discovered at Searles Borax Lake as one of the numerous crystallization products and was described as a new mineral and named by Hidden[1], with an analysis by Mackintosh. Forms: (0001), $(10\bar{1}0)$, $(10\bar{1}1)$, $(20\bar{2}1)$, $(40\bar{4}5)$. Analysed by Mackintosh, Dana and Penfield[1] and by Pratt[1].

	SO_3	CO_2	Cl	Na_2O	K_2O	Insol.	Ign.	
Mackintosh	45.89	5.42	2.36	46.34	--	--	--	= 99.99%
Penfield	43.59	5.42	2.13	40.86	2.33	4.41	1.32	=100.06
Pratt	45.93	5.65	2.21	43.35	2.48	0.19	--	= 99.81
	45.78	5.63	2.28	43.61	2.31	0.12	--	= 99.73

300. LEADHILLITE.

Carbonato-sulphate of lead, $4PbO.SO_3.2CO_2.H_2O$.

Monoclinic. Tabular crystals. Cleavage perfect basal. Color white, yellowish, greenish. Vitreous to pearly luster. H=2.5; G=6.26—6.49.

Inyo County: Found as pale sea-green crystals at the Cerro Gordo mine, associated with linarite and caledonite, with the forms: (001), (110), (100), and a prism, Rogers[1].

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301. CALEDONITE.

Basic sulphate of lead and copper $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.

Orthorhombic. Small crystals. Cleavage perfect basal. Color bluish green and dark emerald green. Resinous to vitreous luster. H=2.5—3; G=6.4.

Inyo County: Occurs as small emerald-green crystals associated with linarite and brochantite at Cerro Gordo. Described by Eakle[7]. Forms: (001), (110), (010), (011), (111), (201), (021), (012), (013), (221), (223), (014), (203).

302. BROCHANTITE.

Basic sulphate of copper, $CuSO_4.3Cu(OH)_2$.

Orthorhombic. Small crystals. Cleavage perfect brachypinacoidal. Color emerald-green, dark green. Vitreous luster. H=3.5—4; G=3.907.

Calaveras County: Druses of small dark green crystals, derived from chalcopyrite, occur at Copperopolis, Rogers[5].

Inyo County: Occurs as small dark emerald-green crystals at the Cerro Gordo mine, associated with linarite and caledonite. The crystals have the forms: (010), (110), (120), (001), (012), (101), (041), Eakle[7].

303. LINARITE.

Basic sulphate of lead and copper $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.

Monoclinic. Small crystals, divergent columnar and platy. Cleavage perfect orthopinacoidal. Color deep azure-blue. Streak pale blue. Vitreous to adamantine luster. H=2.5; G=5.3—5.45.

Inyo County: Beautiful divergent, columnar masses of deep azure-blue linarite were obtained in the Cerro Gordo mines during the early days of mining there, the specimens sometimes being banded with green caledonite and brochantite. Fine crystals were also obtained from pockets and cavities in the massive mineral. The Cerro Gordo, Crapo, St. Ignacio and other mines of the locality contained the linarite in the oxidized zones of the deposit. Rogers[1] gives several of the forms on the linarite crystals. Forms: (001), (100), (110), (010), ($\bar{2}$01), ($\bar{1}$01). Eakle[7] gives additional forms: (210), (012), (011), ($\bar{2}$03), ($\bar{1}$12), ($\bar{2}$11), ($\bar{7}$16), ($\bar{1}\bar{4}$.0.1), ($\bar{3}$02), (211). Crystals show twinning on the orthopinacoid.

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304. MIRABILITE—Glauber Salt.

Hydrous sulphate of sodium, $Na_2SO_4.10H_2O$.

Monoclinic. Generally as crusts and efflorescences. Color white. Vitreous luster. H=1.5—2; G=1.48. Taste salt and bitter.

Mirabilite generally occurs as white crusts and efflorescences and it is sometimes found on the walls of mines where sulphide ores are decomposing. It is also found as crusts about dry alkali lakes.

Napa County: It occurred on the walls of the tunnels in the old Redington cinnabar mine, Knoxville.

San Bernardino County: Forms crusts about some of the dry salt basins of this county.

305. GYPSUM—Gypsite.

Hydrous sulphate of calcium, $CaSO_4.2H_2O$.

Monoclinic. Crystals, massive, granular, fibrous, lamellar. Cleavage perfect clinopinacoidal. Colorless, white, light brown, reddish. Vitreous luster. H=1.5; G=2.31—2.32.

Gypsum is a very common mineral in the State, but extensive deposits of good pure gypsum are exceptional. The mineral is easily formed by the action of sulphated waters on limestone, consequently small amounts of the mineral are usual in mining regions where sulphides are decomposing. Larger deposits are generally bedded deposits formed by the evaporation of lime sulphate waters and these are apt to be quite impure from admixtures of lime carbonate and clay.

Selenite, satin spar, alabaster and *gypsite* are varietal names. The granular, bedded and efflorescent deposits are the only kind in the State of value and the term "gypsite" is generally applied to the material of such deposits.

The locations of some of the deposits are given by Aubury[3] and the mineral is frequently mentioned in descriptions of the counties.

Hess[3] has given us a more recent description of the gypsum resources of the State.

Alpine County: Small amounts occur at Bulliana.

Butte County: Found at the St. Clair mine.

Colusa County: Small amounts occurred with the sulphur at Sulphur Creek.

Contra Costa County: Selenite gypsum is common in the coal seams at Antioch and near Danville. Disks of selenite occur near Clayton.

Fresno County: Deposits of gypsite occur on the low hills on the north and south sides of Tomey Creek, about eighteen miles southwest of Mendota, and along Cantua Creek. In the Coalinga oil district there are frequent occurrences of gypsite.

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Imperial County: Yellow selenite has come from a locality about five miles west of Volcano.

Inyo County: Fibrous gypsum occurs at Clark's Fork, Amargosa River. Small amounts occur in the Cerro Gordo district.

Kern County: Hess[3] reports good deposits of gypsite in the Lost Hills about twenty-five miles west of Wasco. An analysis of the material was made by C. W. Wells and quoted by Hess.

CaO	SO_3	H_2O	Cl	Fe_2O_3	CO_2	SiO_2	Al_2O_3	Na_2O	K_2O	MgO	
29.5	40.7	19.1	none	0.4	0.7	5.3	1.7	1.2	0.6	--	= 99.2%
29.9	40.8	19.4	none	0.3	--	6.1	1.4	2.0	0.5	--	=100.4

Impure gypsite is common in the oil districts and some has been mined in the McKittrick district. Deposits are said to exist on Cottonwood Creek, about sixteen miles east of Bakersfield. Beds of gypsum occur in the bed of old Kern Lake, about twenty miles southwest of Bakersfield and five miles from Connor. Some gypsite occurs on the shores of Buena Vista Lake. Selenite is found with stibnite at the old San Emidio antimony mine. Small deposits of gypsite occur near Cane Springs.

Kings County: Gypsite occurs in deposits on the range of low hills southeast of Dudley and on Kettleman Plains, about five miles northeast of Dudley.

Lake County: Selenite is found on Robinson's ranch. Small amounts are also found at Sulphur Bank, Clear Lake.

Lassen County: Large slabs of selenite occur near Susanville. Observed at Honey Lake.

Los Angeles County: Deposits of good white gypsum occur in Charley Canyon, twelve miles north of Castiac in shale rock. Gypsite and alabaster occur at Palmdale on ridge interbedded with shales. Seams occur in bluffs at San Pedro. A deposit is given two miles north of Lang. Large selenite plates have been found in Soledad Canyon.

Mariposa County: Selenite has been reported from Bear Valley.

Mono County: Occurs in the Bodie district.

Napa County: Small amounts of gypsum were associated with the cinnabar at the old Redington or Boston mine, Knoxville.

Nevada County: Fibrous radiate gypsum occurs near Truckee.

Orange County: Outcrops of gypsum occur in Gypsum Canyon and adjacent canyons, about two miles south of Corona.

Riverside County: Good deposits of gypsum occur in the Palen Mountains interstratified with limestone. Deposits also occur in the Maria Mountains which are thought to be extensive. Some gypsum occurs in the Colorado Desert about twelve miles east of Mecca.

San Benito County: Outcrops of gypsum occur along the Coast Range in many places.

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San Bernardino County: In the dry lake depressions of the desert deposits of gypsite occur but most of them are impure material. A large deposit of this nature occurs at Amboy which is mined at present. Some also is found in the lake beds south of Danby and near Kelso. Gypsum is one of the associated minerals of the borax at Searles Borax Lake. Selenite occurred with colemanite in the Calico district.

San Diego County: Gypsite is found near Dos Palmas.

San Francisco County: Small amounts have been found near Merced Lake. Disks of selenite occur on Seal Rock. Some selenite is found at Fort Point.

San Luis Obispo County: White bunches and veins occur on Alamo Creek, sixteen miles from Santa Maria. Some alabaster occurs at Arroya Grande.

Santa Barbara County: Alabaster occurs near Santa Barbara Creek, about thirty-two miles southwest of McKittrick. Small amounts of alabaster are found on Santa Rosa Island. Massive gypsum was early worked near Point Sal.

Santa Clara County: Selenite occurs near Gilroy.

Sierra County: Small amounts have been found on Kanaka Creek.

Sonoma County: Found at the Geysers with sulphur and with boussingaultite.

Stanislaus County: Selenite is found near Modesto.

Tulare County: Fibrous satin spar at White River.

Ventura County: Small amounts on Dennison Ranch, three miles east of Nordhoff. Selenite occurs in Lockwood Valley.

306. EPSOMITE—Epsom Salts.

Hydrous sulphate of magnesium, $MgSO_4.7H_2O$.

Orthorhombric. Bunches of long slender fibers and fibrous crusts. Cleavage perfect brachypinacoidal. Color white. Vitreous luster. H=2—2.5; G=8.75. Taste bitter and salt.

Efflorescences of epsomite are common in caves and tunnels where pyrite or other sulphides are decomposing in the presence of magnesian rocks. Long hair-like masses of the mineral are common in the cinnabar mines of the State but no epsomite is mined. Commercial epsomite is produced as a by-product in the evaporation of the bitterns of sea water at the salt works.

Alameda County: An efflorescence on the walls of the pyrite mines of Leona Heights. Analysed from the Alma mine by Schaller[1].

		H_2O			
MgO	SO_3	at 100°	ab. 110°	Al_2O_3	
14.8	31.7	40.8	12.2	tr.	=99.5%

Amador County: Common in the mines on Copper Hill.

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Imperial County: Mentioned by Emory[1] as occurring in white crusts on the Colorado Desert.

Lake County: Abundant in the old Abbott quicksilver mine.

Napa County: Abundant in long white fibers in the tunnels of the old Redington mine, Knoxville.

Santa Clara County: Abundant on the walls of the New Almaden and other cinnabar mines of the county.

Sonoma County: An associate of boussingaultite, Goldsmith[6].

307. MORENOSITE.

Hydrous sulphate of nickel, $NiSO_4.7H_2O$.

Orthorhombic. Acicular crystals, fibrous, efflorescent. Color apple-green to greenish white. Vitreous luster. H=2—2.5; G=2. Taste metallic.

Napa County: Said by Becker[1] to coat a specimen of millerite from the Phoenix cinnabar mine.

308. MELANTERITE—Copperas.

Hydrous sulphate of iron, $FeSO_4.7H_2O$.

Monoclinic. Fibrous, stalactitic. Cleavage basal. Color light green to white. Vitreous luster. H=2; G=1.89—1.9

Melanterite is a common formation in mines containing pyrite or marcasite.

Alameda County: Abundant as small fibrous crystals on the walls of the Alma pyrite mine at Leona Heights. Described and analysed by Schaller[1]. Forms: (110), (001), (010), (103), (101), (011), (111), ($\bar{1}21$), (120), (102), (203), (302), (201), (904), (332).

FeO	SO_3	H_2O	CuO	MgO	
28.1	31.2	42.0	none	none	=101.3%

Lake County: Abundant as stalactites in the Sulphur Bank cinnabar mine, Clear Lake.

Mono County: Common in the mines about Lundy.

Napa County: Long pale green stalactites were abundant in the old Redington cinnabar mine, Knoxville.

Santa Cruz County: Specimens have come from the vicinity of Santa Cruz.

Shasta County: Common at Copper City, Bully Hill and other mines of the county.

Sonoma County: Drusy green specimens have been found near Petaluma.

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309. PISANITE.

Hydrous sulphate of iron and copper $(Fe. Cu)SO_4.7H_2O$.

Monoclinic. Long slender prisms, stalactitic. Color greenish blue. Vitreous luster. H=1—2.

Alameda County: One of the secondary sulphates formed with melanterite and chalcanthite on the walls of the Alma pyrite mine on Leona Heights. Described and analysed by Schaller[1]. Forms: (001), (101), (010), (110), (103), (011), (100), (210), (320), (120), ($\bar{1}$01), ($\bar{1}$12), ($\bar{2}$05), (111), ($\bar{3}$35), ($\bar{2}$21), ($\bar{1}$21).

CuO	FeO	SO_3	H_2O at 110°	H_2O ab. 110°	MgO	
15.73	12.31	28.21	45.14		--	=101.39%
9.22	16.47	29.18	45.74		--	=100.61
17.95	5.46	29.25	34.25	10.96	2.82	=100.69

Monterey County: Pale blue crystals from near Gonzales were analysed by Schaller[3].

CuO	FeO	SO_3	H_2O
7.56	15.85	30.74	45.85

310. BOOTHITE.

Hydrous sulphate of copper, $CuSO_4.7H_2O$.

Monoclinic. Fibrous massive. Color greenish blue. Vitreous luster. H=2—2.5; G=1.94—2.1.

Alameda County: This was a new sulphate of copper differing from chalcanthite in the amount of water and crystallization, found with the other sulphates of iron and copper at the Alma pyrite mine, Leona Heights. Described as a new mineral and named by Schaller[1]. Forms: (001), (100), (110), ($\bar{1}$01), ($\bar{3}$01), ($\bar{1}$12), ($\bar{1}$11), ($\bar{1}$21).

CuO	FeO	MgO	SO_3	H_2O at 110°	H_2O ab. 110°	
27.83	tr.	--	28.37	36.64	7.42	=100.26%
28.53	0.28	tr.	28.65	43.76		=101.26

Calaveras County: Crystals of this new sulphate were later found at Campo Seco and analyzed by Schaller[3].

CuO	FeO	MgO	SO_3	H_2O at 110°	H_2O ab. 110°	Insol.	
26.13	0.81	0.64	27.25	36.76	4.91	3.96	=100.46%

311. CHALCANTHITE—Blue Vitriol—Bluestone.

Hydrous sulphate of copper, $CuSO_4.5H_2O$.

Triclinic. Generally in fibrous veins or stalactitic. Color greenish blue to sky-blue. Vitreous luster. H=2.5; G=2.12—2.3.

The natural chalcanthite is found in mines where it results from the alteration of copper sulphides but the amount is generally small

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and unimportant. All of the commercial bluestone is a manufactured product.

Alameda County: It is common in small crystals and seams in the Alma pyrite mine, Leona Heights, and was described and analysed by Schaller[1]. Forms: (001), (010), (100), (110), (120), (1$\bar{1}$0), (1$\bar{2}$0), (011), (0$\bar{2}$1), (0$\bar{3}$1), ($\bar{1}$01), ($\bar{1}$11), ($\bar{1}\bar{3}$1), ($\bar{1}\bar{4}$1).

				H_2O			
CuO	FeO	MgO	SO_3	at 110°	ab. 110°	Insol.	
31.14	none	tr.	32.06	28.20	7.50	0.81	=99.71%

Amador County: Common in the mines on Copper Hill.

Calaveras County: Occurred at Quail Hill, Silliman[5]. Common at Copperopolis.

Nevada County: Found at Sweetland, Hanks[6].

Shasta County: Common evaporation product in the mines of the county and reported from the Peck mine, Copper City, Hanks[6].

312. BLÖDITE.

Hydrous sulphate of magnesium and sodium, $MgSO_4.Na_2SO_4.4H_2O$.

Monoclinic. Prismatic crystals, granular massive. Color white. Vitreous luster. Soft. G=1.67.

Imperial County: Specimens of this rare sulphate are reported to have been found on the Colorado Desert.

San Luis Obispo County: Very large crystals of blödite occur in the mud of Soda Lake, Carisso Plains, which have been described by Schaller [13]. They show the following forms: (001), (110), (210), (011), (111), (2$\bar{0}$1), ($\bar{1}$11), (2$\bar{1}$1), ($\bar{1}$21).

Analysis:

Na_2O	MgO	SO_3	H_2O	
18.26	11.93	48.11	21.37	=99.67%

313. BOUSSINGAULTITE.

Hydrous sulphate of ammonium and magnesium $(NH_4)_2SO_4.MgSO_4.6H_2O$.

Sonoma County: This rare sulphate was described and analyzed by Goldsmith[6]. No locality was given, but presumably it came from the vicinity of the Geysers.

SO_3	MgO	NH_4OH	H_2O
38.86	15.56	5.03	40.55

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314. KALINITE—Potash Alum—Common Alum.

Hydrous sulphate of aluminium and potassium, $K_2SO_4.Al_2(SO_4)_3.24H_2O$.

Isometric. Mealy crusts and fine fibrous. Color white. Vitreous luster. H=2—2.5; G=1.75. Alum taste.

Mealy crusts of alum are rather common in mining regions, formed by the action of sulphated waters on rocks, and are more prominent in association with gypsum deposits. There are several kinds of alum, but the various species have not in general been differentiated. Commercial alum is largely a manufactured product.

Alpine County: Found at the mines of Silver Mountain.

Calaveras County: Observed at Quail Hill, Silliman[5].

Fresno County: Common in the oil district at Coalinga with sulphur.

Inyo County: Occurs on the shores of Owens Lake. Also on the sides of a steaming vent two miles east of Coso Springs, as white crusts, Rogers[5].

Lake County: Common at the Sulphur Bank cinnabar mine.

Los Angeles County: Occurs near Newhall.

Mono County: Found near Bodie.

Napa County: Observed at the Redington cinnabar mine, Knoxville, Melville and Lindgren[1].

Placer County: In the gold mines near Dutch Flat; in slates near Auburn.

Sonoma County: Found at the Geysers.

315. TSCHERMIGITE—Ammonium Alum.

Hydrous sulphate of aluminium and ammonium $(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$.

Isometric. Octahedral crystals, fibrous, crusts. Color white. Vitreous luster. H=1—2; G=1.5.

Lake County: Mentioned by Becker[1] as an efflorescence at Sulphur Bank.

316. HALOTRICHITE—Iron Alum.

Hydrous sulphate of aluminium and iron, $FeSO_4.Al_2(SO_4)_3.24H_2O$.

Monoclinic? Silky fibrous. Color yellowish white. Ink taste.

Alameda County: Found as fibrous masses in the Eureka tunnel, near Livermore.

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317. SONOMAITE—Magnesia Alum.

Hydrous sulphate of aluminium and magnesium, $3MgSO_4.Al_2(SO_4)_3.33H_2O$.

Colorless crystals. Silky luster. G=1.60.

Sonoma County: This alum was described as a new mineral from this county by Goldsmith[5]. No locality was given.

Al_2O_3	FeO	MgO	SO_3	H_2O
7.66	2.01	7.14	38.78	44.41
8.36	1.56	7.51	38.30	44.27

318. COQUIMBITE.

Hydrous sulphate of iron, $Fe_2(SO_4)_3.9H_2O$.

Hexagonal, rhombohedral. Generally granular massive. Color yellowish, brownish, greenish or violet. Vitreous luster. H=2—2.5; G=2.09.

Calaveras County: Mentioned as one of the minerals formed at Quail Hill by Silliman[5].

El Dorado County: Occurs in the shales near Georgetown.

Inyo County: Yellow crystals have been found at Lone Pine.

Napa County: Large masses of yellowish green, granular coquimbite occur at the old Redington cinnabar mine. The mineral was described by Eakle[1] with analysis by Schaller.

Fe_2O_3	Al_2O_3	SO_3	H_2O at 100°	H_2O ab. 100°	FeO	SiO_2	Na_2O	MgO	
12.99	7.44	38.04	23.72	13.71	0.13	0.21	1.68	1.09	=99.04%

Tuolumne County: Silliman[5] mentions it as one of the minerals at Whiskey Hill.

319. ALUNOGEN.

Hydrous sulphate of aluminium, $Al_2(SO_4)_3.18H_2O$.

Monoclinic. Fibrous masses, crusts, powder. Color white. Vitreous to silky luster. H=1.5—2; G=1.6—1.8. Alum taste.

Alameda County: Occurs as a white powder at the Alma mine, Leona Heights, Schaller[1].

Nevada County: Observed at the Providence mine, Nevada City, Lindgren[6].

San Luis Obispo County: Found as a white powder near Paso Robles.

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320. COPIAPITE.

Hydrous sulphate of iron, $2Fe_2O_3.5SO_3.18H_2O$.

Monoclinic. Scaly massive, incrustations. Color sulphur-yellow. Pearly luster. H=2.5; G=2.10.

Alameda County: Found as yellow needles at the Alma mine, Leona Heights, and analysed by Schaller[1].

SO_3	Al_2O_3	Fe_2O_3	FeO	MgO	H_2O	Insol.	
38.36	0.31	25.04	0.44	0.29	29.71	5.43	=99.58%

Lake County: Occurs at Sulphur Bank and analysed by Melville and Lindgren[1].

SO_3	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	Insol.	
38.82	0.37	26.79	3.28	tr.	0.25	0.16	29.58	0.75	=100.00%

Napa County: Found at the old Redington mine, Knoxville, and analysed by Melville and Lindgren[1].

SO_3	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	
39.97	--	26.54	0.46	0.21	--	3.06	30.43	=100.67%

321. KNOXVILLITE.

Hydrous basic sulphate of iron, chromium, aluminum, nickel and magnesium.

Orthorhombic. Tabular crystals. Color greenish yellow. Cleavage perfect basal. Vitreous luster.

Napa County: Greenish yellow masses of this complex sulphate were found in the old Redington mine, Knoxville, and the mineral was described as new by Melville and Lindgren[1]. Forms: (001), (110), (100). Crystals are basal plates.

							H_2O		
SO_3	Fe_2O_3	Cr_2O_3	Al_2O_3	FeO	NiO	MgO	at 100°	ab. 100°	Insol.
35.91	15.36	7.41	4.84	3.81	0.83	3.22	9.29	17.59	1.74

322. REDINGTONITE.

Hydrous sulphate of chromium, aluminium, iron and magnesium.

Finely fibrous to granular massive. Color pale purple. Silky luster. G=1.76.

Napa County: A pale purple sulphate was mixed with the knoxvillite from the Redington mine which was described as a new mineral by Melville and Lindgren[1].

							H_2O				
SO_3	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	NiO	MnO	at 100°	ab. 100°	Insol.		
35.35	5.14	7.51	0.19	4.58	1.00	tr.	1.85	27.09	14.34	3.46	=100.51%

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323. BOTRYOGEN—Palacheite.

Hydrous sulphate of iron and magnesium, $Fe_2O_3.2MgO.4SO_3.15H_2O$.

Monoclinic. Very small crystals. Color brick red, hyacinth-red. Vitreous luster. H=2 — 2.5; G=2.04 — 2.14.

Napa County: Found in bunches of small brick-red crystals in one of the tunnels of the old Redington mine, Knoxville. It was thought to by a new mineral and described and named "palacheite" by Eakle [3]. Its identity with botryogen was later established, Eakle[4] Forms: (110), (010), (001), (120), (450), (021), ($\bar{2}01$), ($\bar{1}11$), ($\bar{1}21$).

			H_2O		
Fe_2O_3	MgO	SO_3	at 100°	ab. 100°	
19.51	9.36	38.37	19.53	12.75	=99.51%

324. ALUNITE.

Hydrous sulphate of aluminium and potassium, $K_2O.3Al_2O_3.4SO_3.6H_2O$.

Hexagonal, rhombohedral. Small crystals and massive. Color white. Vitreous luster. H=3.5 — 4; G=2.58 — 2.75.

Mariposa County: Alunite is a constituent of a quartzite rock found with a greenstone schist in which stellate pyrophyllite occurs, at the Tres Cerritos, southwest of Indian Gulch. Described by Turner[4][5], with analysis by Valentine.

SO_3	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	SiO_2	TiO_2
38.50	38.05	0.23	0.55	tr.	4.48	2.78	11.92	2.64	0.40

P_2O_5		
tr.	=99.55%	Sp. G.=2.78

325. JAROSITE.

Hydrous sulphate of potassium and iron, $K_2O.3Fe_2O_3.4SO_3.6H_2O$.

Hexagonal, rhombohedral. Small platy crystals, fibrous, granular. Color yellowish brown. Streak yellow. Vitreous luster. H=2.5 — 3.5; G=3.15 — 3.26.

Kern County: Micaceous flakes of jarosite have come from this county.

San Benito County: Flakes of jarosite occur at New Idria.

HYDROCARBONS.

The hydrocarbon series of chemical compounds include a number of substances occurring in nature, of a coal-like, pitch-like or oil-like structure, which are almost wholly of organic origin. Many of them

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are separable into a series of different hydrocarbons in varying proportions, thus showing their chemical composition to be quite indefinite. They have no place in a mineral classification, yet their occurrence as natural products in the earth, and the great economic importance of some of them, have been the reasons for their adoption in some works on mineralogy. They belong to the province of organic chemistry.

The two most valuable members of the hydrocarbon series are coal and oil. Coal is pretty generally scattered in the State, but its occurrence is in thin seams which are not segregated sufficiently to form good workable deposits. The coal is of the lignite variety, and black and brown masses of this lignite are occasionally present in the sandstones and limestones. Practically all of the coal used in California is imported.

The lack of coal is more than counterbalanced by the abundance of petroleum. California has one of the greatest oil fields in the world. The oil sands occur at various depths and are of varying thickness and produce oils of greatly diversified character and gravity. The thick series of Miocene shales and sandstones represented by the Monterey formation are the great repository and source of most of the oil of the State.

NAPALITE.

Simple hydrocarbon, C_3H_4.

A dark reddish brown bituminous substance found with cinnabar. Brittle. H=2.

Napa County: Observed at the old Phoenix cinnabar mine, Pope Valley, and was described by Becker[1], with analyses by Melville.

C	H	
89.84	10.17	=100.01%
89.54	10.36	= 99.90
89.33	10.11	= 99.46

IONITE.

A fossil hydrocarbon of earthy texture and brownish yellow color. G=0.90.

Amador County: Found in an argillaceous lignite in thin seams in Ione Valley and described by Purnell[1]. Contains about 50 per cent water and resembles pyropissite.

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ARAGOTITE.

Volatile hydrocarbon.

A hydrocarbon occurring in bright yellow scales at some of the cinnabar mines.

Napa County: Occurred on the cinnabar at the Redington mine, Knoxville, Bertrand[1].

Santa Clara County: First observed at the New Almaden mine impregnating a silicious dolomite and was described by Durand[2].

POSEPNYTE.

Lake County: Plates and nodules of a dirty green and brown oxygenated hydrocarbon were found at the Great Western mine and the substance was described by von Schrockinger[1], with analyses by Dietrich. Part was soluble in ether and part insoluble, the latter corresponding to ozocerite. Becker[1] gives an analysis by Melville of similar material.

	Sol.			Insol.			
	C	H	O	C	H	O	Ash
von Schrockinger	71.84	9.95	18.21	84.27	11.74	3.99	
Melville	----	---	----	83.60	10.71	3.22	0.47

BERNARDINITE.

A substance supposed to be a fossil resin, found as a white porous mass at Santa Ana, San Bernardino County, was described as a new mineral by Stillman[1]. Considered by Brown[1] to be a fungous growth and not a mineral.

PETROLEUM—MINERAL OIL.

The presence of oil in the State has been known by seepages and other indications for many years and some districts have had producing wells for a long time, but the great oil resources of California have only been developed within the past decade, and new fields are constantly being added to the oil areas. The large productive fields are all located in the southern counties, Coalinga, in Fresno County, being the most northerly one. Oil is known to occur, however, in some of the northern counties, but so far the areas have not been very productive. Much difference exists in the oil. Some of it is heavy, thick and black with low gravity, while other wells in the same field produce thin, easily

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flowing, light, high gravity oils. The Monterey shales and sandstones are the source of a large part of the oil in the State.

It is manifestly beyond the scope of this book to give a description of the numerous oil fields within the borders of California.

The Coalinga district in Fresno and Kings counties, the Kern River, and the McKittrick-Sunset districts in Kern County, the Santa Maria and Summerland fields in Santa Barbara County, the Santa Clara field in Ventura County, and the Los Angeles field are the most important fields in the State. Oil is known to exist in several counties in the northern part of the State, but very little oil has been obtained from any of the northern fields.

The geology of the oil fields has been studied by Arnold, Eldridge, Anderson and others of the United States Geological Survey, and their results published in bulletins of the Survey.

BITUMEN—ASPHALT—PITCH—TAR.

The San Pablo and Monterey formations are especially characterized by the bituminous matter which accompanies the shales and sandstones; consequently layers of bitumen and seepages of viscous tar-like matter are common in districts where these shales are exposed. They are especially prominent in the southern counties and some asphalt lakes have formed. The most noted asphalt deposit in the State is on the Rancho de la Brea in Los Angeles County. This deposit served as a trap for the capture of many animals and birds now extinct. The deposit was for a time worked for the asphalt.

Gilsonite or *uintahite* is a variety of asphalt of a brilliant black color. Has been found in Santa Barbara County.

COAL—LIGNITE.

All of the coal of the State is of the soft lignite variety and only occurs in unimportant deposits. Many of the counties can show some seams of coal, and specimens are on exhibition in many of the county exhibits, as well as in the museum of the State Mining Bureau.

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CHAPTER XII.

MINERALS ARRANGED ACCORDING TO THE ELEMENTS.

Every element which enters into the composition of minerals probably occurs in California. It is true that several rare elements like cæsium, gallium, indium and some members of the cerium-yttrium and radium groups have never been detected, but minerals occur in which these elements are usually found, so their presence may yet be revealed when more extensive chemical and spectroscopical analyses of the minerals and rocks have been made.

California is ideal in having passed through all those stages of geologic development which govern the formation of the various species or classes of minerals of igneous, metamorphic and sedimentary genesis, and in possessing the climatic conditions essential to the formation and preservation of unusual mineral species.

Five minerals of commercial importance which are not of world-wide distribution are pre-eminent in California, namely colemanite, cinnabar, magnesite, pink tourmaline and trona.

In the following arrangement of the minerals those in small capitals are in general of commercial importance and common within the State.

ALUMINIUM.

Corundum, Al_2O_3.
Spinel, $MgO.Al_2O_3$.
Chrysoberyl, $BeAl_2O_4$.
Bauxite, $Al_2O_3.2H_2O$.
Dawsonite, $Na_3Al(CO_3)_3.2Al(OH)_3$.
AMBLYGONITE, $Li(AlF)PO_4$.
TURQUOIS, $AlPO_4.Al(OH)_3$.
Kalinite, $K_2SO_4.Al_2(SO_4)_3.24H_2O$.
Tschermigite, $(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$.
Halotrichite, $FeSO_4.Al_2(SO_4)_3.24H_2O$.
Sonomaite, $3MgSO_4.Al_2(SO_4)_3.33H_2O$.
Alunogen, $Al_2(SO_4)_3.18H_2O$.

Also many aluminium silicates, chief of which are the feldspars and kaolinite.

AMMONIUM.

Sal Ammoniac, NH_4Cl.
Mascagnite, $(NH_4)_2SO_4$.
Boussingaultite, $(NH_4)_2SO_4.MgSO_4.6H_2O$.
Tschermigite, $(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$.

ANTIMONY.

Native antimony, Sb.
STIBNITE, Sb_2S_3.
Kermesite, Sb_2S_2O.
Cervantite, Sb_2O_3.
Stibiconite, $Sb_2O_4.H_2O$.
Stibioferrite, Sb_2O_5,Fe_4O_3,H_2O.
Bindheimite, $Pb_3Sb_2O_8.4H_2O$.

Also several sulphantimonites of iron, lead, copper and silver.

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ARSENIC.

Native arsenic, As.
Realgar, AsS.
ARSENOPYRITE, FeAsS.
Smaltite, $CoAs_3$.
Löllingite, $FeAs_2$.
Arsenolite, As_2O_3.
Mimetite, $(PbCl)Pb_4(AsO_4)_3$.

Also several sulpharsenites of copper and silver.

BARIUM.

BARITE, $BaSO_4$.

BERYLLIUM.

Chrysoberyl, $BeAl_2O_4$.
BERYL, $Be_3Al_2Si_6O_{18}$.

BISMUTH.

NATIVE BISMUTH, Bi.
Bismuthinite, Bi_2S_3.
Tetradymite, Bi_2Te.
Bismite, Bi_2O_3.
Bismutosphaerite, Bi_2CO_5.
Bismutite, $Bi_2CO_3.H_2O$.

BORON.

Sassolite, $B_2O_5.3H_2O$.
BORAX, $Na_2B_4O_7.10H_2O$.
COLEMANITE, $Ca_2B_6O_{11}.5H_2O$.
ULEXITE, $NaCaB_5O_9.8H_2O$.
Hydroboracite, $CaMgB_6O_{11}.6H_2O$.
Bakerite, $8CaO.5B_2O_5.6SiO_2.6H_2O$.
HOWLITE, $H_5Ca_2B_5SiO_{14}$.

Also several borosilicates such as tourmaline, axinite and datolite.

BROMINE.

Embolite, Ag(Br,Cl).

CADMIUM.

Greenockite, CdS.

CALCIUM.

CALCITE, $CaCO_3$.
Limestone.
Marble.
DOLOMITE, $(CaMg)CO_3$.
ARAGONITE, $CaCO_3$.
Gay-Lussite, $CaCO_3.Na_2CO_3.5H_2O$.
Pirssonite, $CaCO_3.Na_2CO_3.2H_2O$.
Apatite $(CaF)Ca_4(PO_4)_3$.
SCHEELITE, $CaWO_4$.
GLAUBERITE, $Na_2SO_4.CaSO_4$.
ANHYDRITE, $CaSO_4$
GYPSUM, $CaSO_4.2H_2O$.

Also many calcium silicates chief of which are wollastonite, lime feldspars and lime garnets.

CARBON.

Diamond, C.
GRAPHITE, C.

Also the various hydrocarbons, especially bitumen, petroleum and natural gas.

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CERIUM.

Allanite, Fe,Ca,Ce,Al, Silicate.
Monazite $(Ce,La,Di)PO_4$.

CHLORINE.

HALITE, NaCl.
Sylvite, KCl.
Also several chlorides of the metals and bases.

CHROMIUM.

CHROMITE, $FeCr_2O_4$.
Uvarovite garnet.
Knoxvillite, Fe,Cr, Sulphate.
Redingtonite, Fe,Cr, Sulphate.

COBALT.

Cobaltite, CoAsS.
Smaltite, $CoAs_2$.
Danaite $(Fe,Co)AsS$.
Asbolite, MnO_2,Co,H_2O.
Erythrite, $Co_3As_2O_8.8H_2O$.

COPPER.

NATIVE COPPER, Cu.
CHALCOCITE, Cu_2S.
Stromeyerite $(Cu,Ag)_2S$.
Covellite, CuS.
BORNITE, Cu_3FeS_3
Cubanite, $CuFe_2S_4$.
CHALCOPYRITE, $CuFeS_2$.
Bournonite $(Pb,Cu_2)Sb_2S_6$.
TETRAHEDRITE, $Cu_3Sb_2S_7$.
ENARGITE, Cu_3AsS_4.
Atacamite, $Cu_2ClH_3O_3$.
Partzite, Sb,Cu,H_2O.
CUPRITE, Cu_2O.
Melanconite CuO.
MALACHITE, $CuCO_3.Cu(OH)_2$.
AZURITE, $2CuCO_3.Cu(OH)_2$.
Aurichalcite, $2(Zn,Cu)CO_3.3(Zu,Cu)(OH)_2$.
Chrysocolla, $CuSiO_3.2H_2O$.
Liroconite, Al,Cu, Arsenate.
Cuproscheelite $(Ca,Cu)WO_4$.
Caledonite $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.
Brochantite, $CuSO_4.3Cu(OH)_2$.
Linarite $(Pb,Cu)SO_4.(PbCu)(OH)_2$.
Boothite, $CuSO_4.7H_2O$.
CHALCANTHITE, $CuSO_4.5H_2O$.

FLUORINE.

FLUORITE, CaF_2.
TOPAZ, $Al(O,F_2)AlSiO_4$.
Apatite $(CaF)Ca_4(PO_4)_3$.
AMBLYGONITE, $Li(AlF)PO_4$.

GOLD.

NATIVE GOLD, Au.
Petzite $(Ag,Au)_2Te$.
Sylvanite $(Au,Ag)Te_2$.
Calaverite $(Au,Ag)Te_2$.
Also auriferous pyrite, auriferous arsenopyrite, etc.

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IRON.

Meteoric iron, Fe.
Awaruite, Ni_2Fe.
PYRRHOTITE, $Fe_{11}S_{12}$.
MARCASITE, FeS_2.
PYRITE, FeS_2.
Löllingite, $FeAs_2$.
Berthierite, $FeSb_2S_4$.
HEMATITE, Fe_2O_3.
ILMENITE $(Fe,Ti)_2O_3$.
MAGNETITE, Fe_3O_4.
Göthite, $Fe_2O_3.H_2O$.
LIMONITE, $2Fe_2O_3.3H_2O$.
Also many iron-bearing silicates.

Siderite, $FeCO_3$.
Triphylite, $LiFePO_4$.
Vivianite, $Fe_3P_2O_8.8H_2O$.
MELANTERITE, $FeSO_4.7H_2O$.
Pisanite $(Fe,Cu)SO_4.7H_2O$.
Coquimbite, $Fe_2(SO_4)_3.9H_2O$.
Copiapite, $2Fe_2O_3.5SO_3.18H_2O$.
Knoxvillite, Fe_2O_3,Cr_2O_3,SO_4.
Redingtonite, $Fe_2O_3,Cr_2O_3.SO_4$.
Botryogen, $Fe_2O_3.2MgO.4SO_3.15H_2O$.
Jarosite, $K_2O.3Fe_2O_3.4SO_3.6H_2O$.

LEAD.

Native lead, Pb.
GALENITE, PbS.
Altaite, PbTe.
Jamesonite, $Pb_2Sb_2S_5$.
Dufrenoysite, $Pb_2As_2S_5$.
Bournonite $(Pb,Cu_2)Sb_2S_6$.
Geocronite, $Pb_5Sb_2S_8$.
Minium, Pb_3O_4.

CERUSSITE, $PbCO_3$.
Phosgenite $(PbCl)_2CO_3$
Vanadinite $(PbCl)Pb_4(VO_4)_3$.
Pyromorphite $(PbCl)Pb_4(PO_4)_3$.
Plumbogummite, $PbO.2Al_2O_3.P_2O_5.H_2O$.
Mimetite $(PbCl)Pb_4(AsO_4)_3$.
Bindheimite, $Pb_3Sb_2O_8.4H_2O$.
Wulfenite, $PbMoO_4$.
ANGLESITE, $PbSO_4$.
Leadhillite, $4PbO.SO_3.2CO_2.H_2O$.
Caledonite $(PbCu)SO_4.(PbCu)(OH)_2$.
Linarite $(Pb,Cu)SO_4.(PbCu)(OH)_2$.

LITHIUM.

LEPIDOLITE $(LiK)Al(OH,F)Al(SiO_3)_3$.
TOURMALINE, Lithia-boro-alumina silicate.

Triphylite, $LiFePO_4$.
Lithiophilite, $LiMnPO_4$.
AMBLYGONITE, $Li(AlF)PO_4$.

MAGNESIUM.

Chlormagnesite, $MgCl_2$.
Spinel, $MgO.Al_2O_3$.
Brucite, $MgO.H_2O$.
DOLOMITE $(Ca,Mg)CO_3$.
ANKERITE $(Ca,Mg,Fe)CO_3$.
MAGNESITE, $MgCO_3$.
Also many magnesium silicates, especially serpentine and talc.

Hydromagnesite, $3MgCO_3Mg(OH)_2.3H_2O$.
EPSOMITE, $MgSO_4.7H_2O$.
Blödite, $MgSO_4.Na_2.SO_4.4H_2O$.

MANGANESE.

Hausmannite, Mn_3O_4.
Crednerite, $Cu_3Mn_4O_9$.
Braunite, $3Mn_2O_3MnSiO_3$.
PYROLUSITE MnO_2.
PSILOMELANE, $MnO_2.Mn_2O_3.H_2O$.
MANGANITE, $Mn_2O_3.H_2O$.

Rhodochrosite, $MnCO_3$.
Rhodonite, $MnSiO_4$.
Lithiophilite, $LiMnPO_4$.
Purpurite $(Fe,Mn)_2O_3.P_2O_5.H_2O$.
HÜBNERITE, $MnWO_4$.
WOLFRAMITE $(MnFe)WO_4$

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MERCURY.

NATIVE MERCURY, Hg.
METACINNABARITE, HgS.
CINNABAR, HgS.
Tiemannite, HgSe.
Coloradoite, HgTe.
Calomel, Hg_2Cl_2.
Eglestonite, H_4Cl_2O.

MOLYBDENUM.

MOLYBDENITE, MoS_2.
Molybdite, MoO_3.
Wulfenite, $PbMoO_4$.

NICKEL.

Awaruite, Ni_3Fe.
Millerite, NiS.
Melonite, Ni_2Te_3.
Zaratite, $NiCO_3.2Ni(OH)_2.4H_2O$.
Annabergite, $Ni_3As_2O_8.8H_2O$.
Morenosite, $NiSO_4.7H_2O$.

NIOBIUM—TANTALIUM.

Columbite $(Fe,Mn)Nb_2O_6$.
Stibiotantalite, $m(SbO)_2.Nb_2O_6$ with $n(SbO)_2Ta_2O_6$.

NITROGEN.

Soda niter, $NaNO_3$.
Niter, KNO_3.
Nitrocalcite, $Ca(NO_3)_2.nH_2O$.
Darapskite, $NaNO_3.Na_2SO_4.H_2O$.
Nitroglauberite, $6NaNO_3.2Na_2SO_4.3H_2O$.

PHOSPHOROUS.

Monazite, $(Ce,Di,La)PO_4$.
APATITE, $(CaF)Ca_4(PO_4)_3$.
Pyromorphite, $(PbCl)Pb_4(PO_4)_3$.
AMBLYGONITE, $Li(AlF)PO_4$.
Vivianite, $Fe_3P_2O_8.8H_2O$.
TURQUOIS, $AlPO_4.Al(OH)_3.H_2O$.
Also several rarer phosphates.

PLATINUM GROUP.

PLATINUM, Pt.
Platiniridium, PtIr.
Iridium, Ir.
Osmium, Os.
Iridosmine, IrOs.
Palladium, Pd.
Rhodium, Ro.
Ruthenium, Ru.

POTASSIUM.

Sylvite, KCl.
Niter, KNO_3.
Arcanite, K_2SO_4.
Kalinite, $K_2SO_4.Al_2(SO_4)_3.24H_2O$.
Alunite, $K_2O.3Al_2O_3.4SO_3.6H_2O$.
Jarosite, $K_2O.3Fe_2O_3.4SO_3.6H_2O$.

Also several potassium silicates, chief of which are the potash feldspars and the micas.

SELENIUM.

Tiemannite, HgSe.

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SILICON.

QUARTZ, SiO_2.
CHALCEDONY, SiO_2.
Also the great class of silicates.
Tridymite, SiO_2.
OPAL, $SiO_2.nH_2O$.

SILVER.

Native silver, Ag.
Argentite, Ag_2S.
Stromeyerite $(Ag,Cu)_2S$.
Heśsite, Ag_2Te.
Petzite $(Au,Ag)_2Te$.
Sylvanite $(Au,Ag)Te_2$.
Calaverite $(Au,Ag)Te_2$.
Pyrargyrite, Ag_3SbS_3.
Proustite, Ag_3AsS_3.
Stephanite, Ag_5SbS_4.
Polybasite, Ag_9SbS_6.
Cerargerite, AgCl.
Embolite, Ag(Cl,Br).

SODIUM.

Northupite, $Na_2CO_3MgCO_3.NaCl$.
Tychite, $2Mg.CO_3.2Na_2CO_3.Na_2SO_4$.
Dawsonite, $Na_3Al(CO_3)_3.2Al(OH)_3$.
Thermonatrite, $Na_2CO_3.H_2O$.
Gay-Lussite, $CaCO_3.Na_2CO_3.5H_2O$.
NATRON, $Na_2CO_3.10H_2O$.
TRONA, $Na_2CO_3.HNaCO_3.2H_2O$.
Pirssonite, $CaCO_3.Na_2CO_3.2H_2O$.
Soda niter, $NaNO_3$.
Sulfohalite, $3Na_2SO_4.2NaCl$.
Darapskite, $NaNO_3.Na_2SO_4.H_2O$.
Nitroglauberite, $6NaNO_3.2Na_2SO_4.3H_2O$.
BORAX, $Na_2B_4O_7.10H_2O$.
ULEXITE, $NaCaB_5O_9.8H_2O$.
THENARDITE, Na_2SO_4.
GLAUBERITE, $Na_2SO_4.CaSO_4$.
HANKSITE, $4NaSO_4.Na_2CO_3$.
Mirabilite, $Na_2SO_4.10H_2O$.
Blödite, $MgSO_4.Na_2SO_4.4H_2O$.
Also several sodium silicates, chief of which are the sodium feldspars.

STRONTIUM.

Strontianite, $SrCO_3$.
Celestite, $SrSO_4$.

SULPHUR.

NATIVE SULPHUR, S.
Also pyrrhotite and other sulphides.
PYRITE, FeS_2.

TELLURIUM.

Native tellurium, Te.
Tetradymite, Bi_2Te.
Hessite, Ag_2Te.
Petzite $(Ag,Au)_2Te$.
Altaite, PbTe.
Coloradoite, HgTe.
Melonite, Ni_2Te_3.
Sylvanite $(Au,Ag)Te_2$.
Calaverite $(Au,Ag)Te_2$.

TIN.

Native tin, Sn.
Cassiterite, SnO_2.

TITANIUM.

ILMENITE, $(Fe,Ti)_2O_3$.
Rutile, TiO_2.
Brookite, TiO_2.
Octahedrite, TiO_2.
Titanite, $CaTiSiO_5$.
BENITOITE, $BaTiSi_3O_9$.
Neptunite, $(Na,K)_2(Fe,Mn)TiSi_4O_{12}$.

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TUNGSTEN.

HÜBNERITE, $MnWO_4$.
WOLFRAMITE $(Mn,Fe)WO_4$.
SCHEELITE, $CaWO_4$.
Cuproscheelite $(Ca,Cu)WO_4$.

URANIUM.

Uraninite, Uranate of lead.
Uraconite, Uranate of lead, H_2O.

VANADIUM.

Roscoelite $H_8K(Mg,Fe)(Al,V)_4(SiO_3)_{12}$.
Pucherite, $BiVO_4$.
Vanadinite $(PbCl)Pb_4(VO_4)_3$.
Volborthite, Cu,Ba,Ca, Vanadate.
Cuprodescloizite, Pb, Zn, Cu, Vanadate.

ZINC.

Native zinc, Zn.
SPHALERITE, ZnS.
Voltzite, Zn_5S_4O.
SMITHSONITE, $ZnCO_3$.
Aurichalcite, $2(Zn,Cu)CO_3.3(Zn,Cu)(OH)_2$.
Hydrozincite, Basic zinc carbonate.
Calamine, $H_2Zn_2SiO_5$.

ZIRCONIUM.

ZIRCON, $ZrSiO_4$.

GEM MINERALS.

AGATE.
Amethyst.
Axinite
BENITOITE.
BERYL.
CALIFORNITE.
Carnelian.
CHALCEDONY.
Chiastolite.
Chrysoberyl.
Chrysolite.
CHRYSOPAL.
CHRYSOPRASE.
Crocidolite.
DIAMOND.
Dumortierite.
GARNET.
Hiddenite.
JASPER.
Kinradite.
KUNZITE.
Lapis Lazuli.
Moonstone.
Myrickite.
OPAL.
QUARTZ.
Rhodonite.
Ruby.
Sapphire.
Satelite.
Rutile.
Spinel.
Titanite.
Topaz.
TOURMALINE.
TURQUOIS.
Vesuvianite.
Zircon.

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MINERAL DISTRIBUTION BY COUNTIES.

All of the minerals mentioned in the foregoing pages are listed by counties in order to show their distribution. The particular locality or description of any mineral can easily be seen by reference to the mineral. There are many scattered localities and several which are noted for the great variety of associated minerals. The desert counties lead in number of species because they have minerals not only typical of mountainous regions, such as vein minerals, contact metamorphic minerals and secondary minerals in the oxidization zones of veins, but in addition, minerals typical of the dry plains and former marshes and lakes, such as the borates, sulphates, carbonates, nitrates and chlorides. Inyo and San Bernardino counties therefore lead, and the Cerro Gordo district and Death Valley in the former, and the Searles Borax Lake and Calico district in the latter, are the most famous single localities.

San Diego County ranks as the gem county of the State. The great series of lithia-bearing pegmatites which intersect the diorites at Pala and Mesa Grande contain the beautiful pink tourmaline and pink kunzite with many associated minerals.

The minerals occurring in the gold regions of the Sierras are in general the common sulphides and rock-forming minerals. Carson Hill in Calaveras County and the mines near Jamestown and Tuttletown in Tuolumne County were noted for the rarer telluride minerals associated with the gold.

Some of the cinnabar mines have also been noted for rare and interesting mineral associations. Several new species came from the old Redington mine, afterwards named the Boston mine, at Knoxville, Napa County. The Sulphur Bank mine, on Clear Lake, Lake County, and the New Almaden mine, Santa Clara County, have produced several rare minerals.

Other localities are known for their mineral associations, but it is only of those districts which have been studied by men who have known the minerals, that we have fairly complete lists.

Alameda County.—Actinolite, alunogen, analcite, boothite, calcite, chalcanthite, chalcedony, chalcopyrite, chromite, cinnabar, coal, copiapite, copper, cuprite, enstatite, epsomite, halite, halotrichite, hematite, hydromagnesite, kämmererite, limonite, magnesite, manganite, melanterite, natrolite, petroleum, pisanite, psilomelane, pyrite, pyrolusite, pyrophyllite, rhodochrosite, rhodonite, serpentine, talc, vivianite, zircon.

Alpine County.—Argentite, arsenolite, barite, biotite, calcite, chalcocite, chalcopyrite, enargite, famatinite, galena, garnet, gold, gypsum, hematite, jasper, kalinite, marcasite, polybasite, pyrargyrite, pyrite, realgar, rose quartz, silver, sphalerite, stephanite, stromeyerite, tetrahedrite, tourmaline, wood opal.

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Amador County.—Amethyst, arsenopyrite, biotite, calcite, chalcanthite, chalcedony, chalcopyrite, chromite, chrysocolla, clay, coal, copper, cuprite, diamond, epsomite, galena, gold, ilmenite, ionite, limonite, löllingite, magnetite, malachite, pyrite, pyrolusite, rectorite, rock crystal, rose quartz, rutile, serpentine, talc, tellurium, tremolite, wood opal.

Butte County.—Asbestos, barite, californite, chromite, chrysoberyl, diamond, epidote, garnet, gold, gypsum, hematite, hornblende, ilmenite, lead, limonite, magnetite, marble, monazite, olivine, prochlorite, platinum minerals, rhodochrosite, rhodonite, rutile, smoky quartz, talc, topaz, vesuvianite, wood opal, zircon.

Calaveras County.—Albite, altaite, ankerite, aragonite, arsenopyrite, azurite, barite, boothite, bornite, brochantite, calcite, calaverite, chalcanthite, chalcedony, chalcocite, chalcopyrite, chloritoid, chromite, chrysocolla, copper, coquimbite, covellite, cuprite, dolomite, epidote, galena, garnet, gold, graphite, hematite, hessite, hyalite, ilmenite, jamesonite, jasper, kalinite, limonite, lithomarge, magnesite, magnetite, malachite, manganite, margarite, mariposite, melanconite, melonite, millerite, opal, orthoclase, petzite, platinum minerals, pyrite, pyromorphite, pyrolusite, pyrrhotite, quartz, rectorite, silver, sphalerite, stibnite, sylvanite, talc, tellurium, tetradymite, tetrahedrite, uraconite, uraninite, valencianite, vivianite, wood opal, zircon.

Colusa County.—Aragonite, chalcotrichite, coal, chromite, cinnabar, copper, cuprite, electrum, gypsum, lignite, manganite, melanconite, metacinnabarite, pyrite, pyrolusite, sulphur.

Contra Costa County.—Actinolite, albite, analcite, anthophyllite, apatite, clay, coal, crossite, diopside, enstatite, epidote, fluorite, glaucophane, gypsum, hyalite, lawsonite, manganite, opal, petroleum, prochlorite, psilomelane, pyrolusite, serpentine, talc, titanite, tremolite, zircon.

Del Norte County.—Agate, awaruite, bornite, chalcedony, chalcocite, chalcopyrite, chromite, cinnabar, copper, cuprite, diamond, enstatite, garnet, gold, graphite, hematite, ilmenite, jasper, kämmererite, magnetite, melanconite, monazite, olivine, penninite, platinum minerals, pyrrhotite, tetrahedrite, wollastonite, zircon.

El Dorado County.—Adularia, agalmatolite, anatase, arsenopyrite, asbestos, axinite, barite, bismuth gold, bornite, brookite, calaverite, calcite, chalcocite, chalcopyrite, chloropal, chromite, cinnabar, clay, copper, coquimbite, cubanite, diamond, enargite, epidote, galena, garnet, gold, hematite, hessite, hornblende, ilmenite, limonite, ludwigite, magnetite, meteorite, molybdenite, monazite, nontronite, orthoclase, petzite, platinum, pyrolusite, pyromorphite, pyrophyllite, quartz, roscoelite, serpentine, sphalerite, talc, tin, titanite, tourmaline, vesuvianite, zircon.

Fresno County.—Andalusite, apatite, asbestos, barite, bismuthinite, bismutite, bornite, californite, chalcopyrite, chromite, chrysocolla, cinnabar, coal, columbite, copper, diamond, epidote, garnet, gold, graphite, gypsum, ilmenite, kalinite, magnesite, magnetite, molybdenite, moss opal, petroleum, pyrrhotite, stilbite, tantalite, titanite, tourmaline, turquois, vesuvianite, zaratite, zircon.

Glenn County.—Chromite, copper, cuprite, talc, volborthite.

Humboldt County.—Agate, carnelian, chalcedony, chalcocite, chalcopyrite, chromite, coal, copper, garnet, gold, graphite, hematite, ilmenite, jasper, jet, magnetite, monazite, olivine, petroleum, platinum minerals, prase, pyrrhotite, rutile, spinel, vivianite, zircon.

Imperial County.—Arsenopyrite, blödite, chalcopyrite, cyanite, dumortierite, electrum, epsomite, gypsum, halite, sulphur, tetrahedrite.

Inyo County.—Anglesite, anhydrite, argentite, asbestos, atacamite, aurichalcite, axinite, azurite, barite, bindheimite, bismuthinite, bismutite, boracite, borax, bornite, botryogen, bournonite, brochantite, calamine, calcite, caledonite, celestite, cerargerite, cerussite, cervantite, chalcocite, chalcopyrite, chrysocolla, cinnabar, colemanite, copper, coquimbite, covellite, cuprite, darapskite, datolite, dawsonite, dolomite, dufrenoysite, embolite, epidote, fluorite, galena, garnet, gay-lussite, geocronite, göthite, gold, gypsum, halite, halloysite, hanksite, hematite, hydro-

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magnesite, hydrozincite, jamesonite, jasper, kalinite, leadhillite, lenzinite, limonite, linarite, liroconite, malachite, malacolite, marble, metacinnabarite, mimetite, molybdenite, montmorillonite, mountain cork, muscovite, natron, niter, nitroglauberite, orthoclase, petzite, phosgenite, platinum, plumbogummite, pyromorphite, rock crystal, sal ammoniac, sepiolite, serpentine, siderite, silver, smithsonite, soda niter, sphalerite, stibnite, stromeyerite, sulphur, sylvite, talc, tetrahedrite, thenardite, thermonatrite, tourmaline, tremolite, trona, ulexite, vesuvianite, willemite, wolframite, wulfenite.

Kern County.—Antimony, argentite, arsenopyrite, asphalt, barite, borax, cerargerite, cervantite, chalcedony, chalcopyrite, chloropal, cinnabar, clay, coccinite, colemanite, cuprite, cuproscheelite, enstatite, galena, garnet, gilsonite, gypsite, halite, hematite, hessite, ilmenite, jarosite, kermesite, lead, lepidomelane, magnesite, magnetite, marble, meteorite, minium, opal, orthoclase, petroleum, platinum minerals, proustite, pyrargyrite, scheelite, sepiolite, silver, smithsonite, stibiconite, stibnite, sulphur, talc, tourmaline, ulexite, wulfenite.

Kings County.—Cinnabar, gypsite.

Lake County.—Borax, chromite, cimolite, cinnabar, clay, copiapite, crocidolite, epsomite, gypsum, kalinite, melanterite, mercury, metacinnabarite, opal, posepnyte, sassolite, serpentine, stibnite, sulphur, tiemannite, tschermigite, violan, wollastonite, zoisite.

Lassen County.—Annabergite, bernardinite, garnet, gypsum, halloysite, jefferisite, mesolite, muscovite, smaltite, sulphur, tourmaline, wood opal.

Los Angeles County.—Anhydrite, annabergite, argentite, asbolite, asphalt, barite, bismutite, bornite, calcite, chalcocite, chrysocolla, colemanite, copper, corundum, cyanite, diatomaceous earth, diopside, epidote, erythrite, fluorite, galena, garnet, graphite, gypsum, howlite, ilmenite, kalinite, labradorite, lapis lazuli, lazulite, leucopyrite, magnetite, olivine, orthoclase, petroleum, sal ammoniac, siderite, silver, smaltite, sphalerite, stibnite, talc, tetrahedrite, ulexite, vesuvianite, vivianite.

Madera County.—Bismuthinite, chalcocite, chalcopyrite, chromite, covellite, electrum, galena, hematite, ilmenite, lazurite, magnetite, molybdenite, orthoclase, pyrrhotite, vivianite, wolframite, zaratite.

Marin County.—Actinolite, agate, albite, asbestos, chalcedony, chalcopyrite, epidote, garnet, glaucophane, hematite, jasper, kinradite, lawsonite, manganite, margarite, psilomelane, pyrolusite, pyrophyllite, pyrrhotite, talc, titanite, wolframite, zircon.

Mariposa County.—Alunite, andalusite, ankerite, arsenopyrite, asbestos, azurite, barite, biotite, bronzite, calcite, chalcocite, chalcopyrite, chloropal, chrysocolla, cinnabar, cobaltite, copper, covellite, danaite, erythrite, epidote, galena, garnet, gold, gold amalgam, göthite, gypsum, hornblende, ilmenite, limonite, malachite, mariposite, molybdenite, orthoclase, pitticite, pyrite, pyromorphite, pyrrhotite, pyrophyllite, rock crystal, scorodite, serpentine, sillimanite, sphalerite, stibnite, sulphur, talc, tetrahedrite, tourmaline, wolframite.

Mendocino County.—Chromite, copper, garnet, graphite, jefferisite, magnesite, manganite, olivine, platinum minerals, pyrolusite, tetrahedrite, zircon.

Merced County.—Calcite, cinnabar, copper, stibnite.

Modoc County.—Clay, hematite, magnetite, natrolite, stilbite.

Mono County.—Anglesite, anhydrite, ankerite, argentite, arsenopyrite, azurite, barite, bismite, bismuthinite, bismutite, bornite, calcite, cerargerite, cerussite, chalcedony, chalcopyrite, chrysocolla, cinnabar, clay, cobaltite, copper, cuprite, diatomaceous earth, embolite, fluorite, galena, geocronite, gold, greenockite, gypsum, halloysite, hematite, hornblende, kalinite, lazulite, magnetite, malachite, melanterite, molybdenite, molybdite, orthoclase, partzite, proustite, pyrargyrite, pyrrhotite, quartz, rutile, silver, sphalerite, stephanite, stetefeldtite, stibnite, tetrahedrite, travertine, tridymite.

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Monterey County.—Arsenic, bitumen, chalcedony, chromite, cinnabar, coal, diatomaceous earth, garnet, graphite, iddingsite, magnetite, metacinnabarite, orthoclase, pisanite, serpentine, stibnite, zaratite.

Napa County.—Asbestos, barite, botryogen, calomel, chalcedony, cinnabar, copiapite, copper, coquimbite, covellite, crednerite, cuprite, epsomite, erythrite, gypsum, hematite, jamesonite, jasper, kalinite, knoxvillite, lithomarge, magnesite, marcasite, melanterite, mercury, metacinnabarite, millerite, mirabilite, molybdenite, morenosite, napalite, pyrolusite, redingtonite, rock crystal, serpentine, smaltite, stibnite, sulphur, talc, wollastonite, wood opal.

Nevada County.—Agate, altaite, alunogen, andalusite, anorthite, anorthoclase, argentite, arsenopyrite, asbestos, axinite, barite, biotite, bismuth, calcite, chabazite, chalcanthite, chalcedony, chalcopyrite, chromite, chrysocolla, cinnabar, clay, cobaltite, copper, cuprite, danaite, diallage, diamond, dolomite, enstatite, epidote, galena, garnet, gold, gold amalgam, gypsum, hematite, hessite, hornblende, ilmenite, jasper, labradorite, limonite, magnesite, magnetite, marcasite, melaconite, microcline, molybdenite, molybdite, olivine, orthoclase, platinum, psilomelane, pyrargyrite, pyrite, pyrolusite, pyrrhotite, rock crystal, scheelite, sericite, serpentine, smaltite, sphalerite, stephanite, talc, tetradymite, tetrahedrite, tourmaline, uralite, wernerite, wollastonite, wood opal, zircon.

Orange County.—Arcanite, anhydrite, barite, cinnabar, diatomaceous earth, fuchsite, galena, garnet, gypsum, hematite, ilmenite, magnetite, metacinnabarite, petroleum, tiemannite, tourmaline.

Placer County.—Aragonite, arsenopyrite, asbestos, barite, calcite, cerargerite, chalcedony, chalcocite, chalcopyrite, chromite, chloropal, clay, clinochlore, coal, cobaltite, copper, cuprite, electrum, epidote, garnet, gold, hematite, ilmenite, kalinite, kämmererite, kotschubeite, limonite, magnesite, magnetite, manganite, marble, millerite, molybdenite, monazite, platinum minerals, psilomelane, pyrite, pyrolusite, pyrrhotite, rhodochrosite, rock crystal, serpentine, silver, sphalerite, talc, tetrahedrite, tourmaline, tremolite, wood opal, zircon.

Plumas County.—Albite, arsenopyrite, apatite, bornite, braunite, cassiterite, chabazite, chalcocite, chalcopyrite, chromite, chrysocolla, copper, corundum, crocidolite, cuprite, diallage, edenite, epidote, galena, garnet, gold, hausmannite, hematite, hornblende, hypersthene, ilmenite, jasper, leucoxene, limonite, magnetite, malachite, manganite, millerite, molybdenite, monazite, oligoclase, olivine, platinum minerals, psilomelane, pyrolusite, pyrophyllite, pyrrhotite, quartz, rhodonite, serpentine, silver, sphalerite, strontianite, tetrahedrite, titanite, tremolite, wood opal, wulfenite, zircon, zoisite.

Riverside County.—Andalusite, axinite, bauxite, beryl, biotite, bismuthinite, borax, brucite, calcite, cassiterite, chalcopyrite, chondrodite, clay, clinochlore, copper, corundophyllite, diopside, galenite, garnet, greenockite, gypsum, halite, hematite, hydromagnesite, kunzite, lepidolite, magnesite, magnetite, manganite, monticellite, muscovite, niter, okenite, pyrolusite, sphalerite, spinel, stibnite, stromeyerite, talc, tourmaline, vesuvianite, wilkeite, wollastonite, xanthophyllite.

Sacramento County.—Chromite, galena, hornblende, magnetite, rock crystal, sphalerite, talc, vesuvianite, zircon.

San Benito County.—Acmite, actinolite, aegirite, albite, aragonite, benitoite, calcite, chalcocite, chromite, chrysocolla, cinnabar, coal, crossite, garnet, glaucophane, gypsum, jarosite, kämmererite, mercury, metacinnabarite, natrolite, neptunite, penninite, psilomelane, rhodochrome, rock crystal, serpentine, stibiconite, stibnite, talc, tourmaline, valentinite, zaratite, zircon.

San Bernardino County.—Anhydrite, anthophyllite, aragonite, argentite, arsenolite, asbeferrite, asbestos, asbolite, bakerite, barite, bernardinite, borax, bornite, calamine, calcite, cassiterite, celestite, cerargerite, cerussite, chalcedony, chalcocite, chalcopyrite, chlormagnesite, chrysocolla, clay, colemanite, cookeite, corundum, cummingtonite, cuprite, cuprodescloizite, darapskite, embolite, enstatite, epidote, fluorite, galena, gay-lussite, glauberite, graphite, gypsite, halite,

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hanksite, heliotrope, hematite, howlite, hyalite, hydroboracite, ilmenite, lapis lazuli, laumontite, lepidolite, magnetite, malachite, marble, meteorite, mimetite, mirabilite, moss agate, muscovite, myrickite, niter, nitrocalcite, nitroglauberite, northupite, nosean, opal, orthoclase, pirssonite, priceite, psilomelane, pyrolusite, quartz, realgar, rhodochrosite, sal ammoniac, sassolite, scheelite, silver, smithsonite, soda niter, sphalerite, stibnite, stromeyerite, sulphohalite, sulphur, talc, tetrahedrite, thenardite, thermonatrite, tourmaline, trona, turquois, tychite, ulexite, vanadinite, voltzite, wolframite, wulfenite, zinc.

San Diego County.—Agalmatolite, albite, amblygonite, anorthite, apatite, arsenopyrite, asbestos, axinite, beryl, bismite, bismuth, bismutite, bismutosphaerite, calcite, cassiterite, chalcocite, chalcopyrite, columbite, corundum, cyanite, diatomaceous earth, dumortierite, epidote, garnet, graphite, gypsite, halloysite, heulandite, hematite, hiddenite, hyalite, hypersthene, hureaulite, kunzite, laumontite, lazulite, lepidolite, lithiophilite, microcline, microlite, molybdenite, montmorillonite, muscovite, olivine, orthoclase, palaite, piedmonite, prehnite, pucherite, purpurite, pyrochlore, pyrophyllite, rock crystal, rock soap, rose quartz, rutile, salmonsite, scheelite, sicklerite, sillimanite, spinel, spodumene, stewartite, stibiotantalite, stilbite, strengite, talc, titanite, tourmaline, topaz, triphylite, vesuvianite, zircon.

San Francisco County.—Apatite, apophyllite, aragonite, barite, brucite, calcite, cinnabar, datolite, diallage, diopside, enstatite, gypsum, gyrolite, hydrodolomite, hydromagnesite, hypersthene, ilmenite, jasper, kinradite, lignite, magnesite, magnetite, mercury, olivine, opal, pectolite, serpentine, titanite.

San Joaquin County.—Diatomaceous earth, manganite, pyrolusite.

San Luis Obispo County.—Allophane, alunogen, asphalt, bitumen, calcite, chromite, cinnabar, copper, cubanite, diatomaceous earth, enstatite, glaucophane, gypsum, halite, hydromagnesite, ilmenite, lawsonite, limonite, magnesite, magnetite, manganite, metacinnabarite, onyx, marble, platinum sands, prehnite, pyrophyllite, spinel, thenardite, tourmaline, wulfenite, zircon.

San Mateo County.—Agate, barite, calcite, calomel, celadonite, chalcedony, chromite, diallage, diatomaceous earth, eglestonite, jasper, magnetite, margarite, mercury, olivine, pyrolusite, zircon.

Santa Barbara County.—Agate, allanite, analcite, asphalt, augite, barite, calcite, chalcedony, chalcodite, cinnabar, dolomite, fluorite, garnet, gilsonite, gypsum, hornblende, ilmenite, labradorite, magnesite, magnetite, petroleum, platinum minerals, prehnite, rock soap, sal ammoniac, stibnite, stilbite, serpentine, vivianite, wollastonite, zircon.

Santa Clara County.—Actinolite, apophyllite, aragotite, augite, bornite, caranthine, cataphorite, chromite, cinnabar, clinozoisite, crocidolite, deweylite, diallage, dolomite, epidote, epsomite, garnet, glaucophane, gypsum, gyrolite, lawsonite, limonite, lotrite, magnesite, magnetite, manganite, margarite, mercury, metacinnabarite, oligoclase, omphacite, paragonite, paragasite, petroleum, pilinite, pyrite, pyrolusite, rhodonite, rutile, smaragdite, serpentine, soretite, stibiconite, stibioferrite, stibnite, talc, tiemannite, titanite, zoisite.

Santa Cruz County.—Bitumen, calcite, coal, graphite, ilmenite, magnetite, melanterite, olivine, petroleum, platinum sands, talc, tremolite, vesuvianite, zircon.

Shasta County.—Asbestos, barite, bornite, calcite, chalcanthite, chalcocite, chalcopyrite, chromite, cinnabar, copper, covellite, cuprite, deweylite, diatomaceous earth, epidote, galena, garnet, gold, halite, hedenbergite, hematite, hessite, ilmenite, ilvaite, limonite, magnetite, melanconite, melanterite, mesolite, molybdenite, orthoclase, platinum minerals, proustite, pyrargyrite, pyrite, pyrrhotite, siderite, silver, sphalerite, spinel, talc, tellurium, tetrahedrite, zinc, zircon, zoisite.

Sierra County.—Arsenopyrite, asbestos, chalcopyrite, chromite, gold, hessite, magnetite, mariposite, natrolite, platinum minerals, pyrolusite, quartz, serpentine, stibnite, talc, wood opal.

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Siskiyou County.—Asbestos, barite, californite, cassiterite, chalcopyrite, chromite, cinnabar, copper, diamond, galena, garnet, gold, graphite, hematite, hypersthene, ilmenite, limonite, jasper, marble, olivine, opal, ottrelite, platinum, platiniridium, pyrite, pyrolusite, pyrrhotite, rhodonite, scheelite, sphalerite, spinel, talc, tin, vesuvianite, zircon.

Solano County.—Aragonite, calcite, cinnabar, onyx, marble, sulphur.

Sonoma County.—Actinolite, aragonite, boussingaultite, calcite, chromite, cinnabar, clay, coal, diatomaceous earth, epsomite, garnet, geyserite, graphite, gypsum, hematite, jasper, kalinite, limonite, magnesite, manganite, margarite, mascagnite, melanterite, natrolite, psilomelane, pyrite, pyrolusite, serpentine, smaragdite, sonomaite, stratopeite, sulphur, talc, wood opal, zircon, zoisite.

Stanislaus County.—Asbestos, cinnabar, clay, gypsum, hematite, magnesite.

Sutter County.—Clay, coal.

Tehama County.—Chromite, copper, diatomaceous earth, galena, garnet, graphite, pectolite, platinum minerals, sulphur, talc, wollastonite.

Trinity County.—Asbestos, barite, cassiterite, chalcopyrite, chromite, cinnabar, cuprite, diamond, garnet, gold, hematite, ilmenite, magnetite, mercury, meteorite, platinum minerals, pyrite, realgar, serpentine, sylvanite, talc, zircon.

Tulare County.—Agate, annabergite, arsenopyrite, asbestos, californite, chalcopyrite, chrysopal, chrysoprase, copper, cuprite, diatomaceous earth, epidote, galena, garnet, graphite, gypsum, jefferisite, limonite, magnesite, magnetite, malacolite, minium, molybdenite, opal, orthoclase, pyromorphite, rhodonite, rock crystal, rose quartz, satelite, scheelite, sphalerite, stibnite, stilbite, sulphur, talc, tourmaline, wood opal.

Tuolumne County.—Albite, altaite, ankerite, aragonite, asbestos, berthierite, beryl, calcite, chalcanthite, chalcocite, chalcopyrite, chromite, coloradoite, coquimbite, cuprite, cyanite, diallage, dumortierite, enstatite, epidote, erythrite, galena, garnet, gold, graphite, hematite, hessite, ilmenite, jasper, kalinite, magnetite, manganite, marble, mariposite, molybdenite, molybdite, orthoclase, petzite, psilomelane, pyrite, pyrolusite, pyrrhotite, quartz, rhodonite, serpentine, sphalerite, talc, tellurium, tetradymite, tetrahedrite, tin, tourmaline, tremolite, tridymite, wollastonite, wood opal.

Ventura County.—Colemanite, gypsum, hydroboracite, lenzinite, mesolite, millerite, muscovite, petroleum, platinum sands, sulphur.

Yolo County.—Asbestos, cinnabar, limonite, metacinnabarite.

Yuba County.—Bauxite, chromite, epidote, gold, hematite, ilmenite, magnetite, monazite, olivine, pilinite, platinum sands, rutile, talc, serpentine, vivianite, zircon.

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